EPA-340/1-86-010

Recommended Quality Assurance Procedures for Opacity Continuous Emission Monitoring Systems

Prepared by

James W. Peeler
CEM/Engineering Division
Entropy Environmentalists, Inc.
Research Triangle Park, North Carolina 27709

Under Contract No. 68-02-3962
Work Assignments 2-52 and 3-101
With JACA Corp.
Fort Washington, PA 19039

Prepared for

EPA Project Officer: John Busik
EPA Work Assignment Managers: Anthony Wayne
and Mary Cunningham

U.S. ENVIRONMENTAL PROTECTION AGENCY
Stationary Source Compliance Division
Office of Air Quality Planning and Standards
Washington, D.C. 20460

February 1986

DISCLAIMER

This material has been funded wholly or in part by the United States Environmental Protection Agency under Contract 68-02-3962 to Entropy Environmentalists, Inc. It has been subject to the Agency's peer and administrative review, and it has been approved for publication as an EPA document. Mention of trade names or commercial products does not constitute endorsement or recommendation for use."

TABLE OF CONTENTS

		Page
1.0	Introduction	1
2.0	Elements of An Opacity CEMS QA Program	2
	2.1 Daily QA Checks	2
	2.2 Periodic QA Checks/Preventive Maintenance	4
	2.3 Corrective Action Procedures	8
	2.4 Accuracy Checks	9
3.0	Organization of QA Activities	11
4.0	QA Plan Implementation and Revision	13
	4.1 Establish Initial QA Objectives	13
	4.2 Develop Draft QA Plan	15
	4.3 Initial Trial Implementation and Debugging	15
	4.4 Finalize Initial QA Plan	16
	4.5 Implement Current QA Plan	16
	4.6 Review of QA Records and Information	16
	4.7 Revision of the QA Plan	16
	4.8 Notify/Train Involved Personnel	17
5.0	Organization of QA Responsibilities	18

Appendix A. Example Quality Assurance Plans

Appendix B. Example Quality Assurance Data Summaries

1.0 INTRODUCTION

This report presents recommended quality assurance (QA) procedures for opacity continuous emission monitoring systems (CEMS's) installed at electric utility steam generating stations. The recommended procedures are based on experience and information gained from the Opacity CEMS Pilot Project that was conducted in Missouri. As part of this project, QA procedures for opacity CEMS's were developed, implemented, and evaluated during approximately one-year of field study.

The field study included opacity CEMS's installed on six coal-fired electric utility generating units located at four generating stations, each of which is owned by a different utility company. The sources included in this study were selected to be representative of a wide range of monitoring applications and conditions, and were equipped with contemporary opacity monitoring instrumentation provided by the three major CEMS manufacturers. Detailed descriptions of the sources, opacity CEMS's, and QA procedures that were evaluated during the project are included in "Evaluation of Opacity CEMS Reliability and QA Procedures, " CEMS Pilot Project Report, March 1986.

The recommended QA procedures contained in this report are intended to provide a simple, cost-effective approach to the development and implementation of opacity CEMS QA plans. The recommended approach allows for much flexibility in the selection of monitor- and source-specific procedures, the establishment of QA control limits, and the organization of the quality assurance elements. Because of the flexibility retained in the recommended procedures, source personnel may use them to develop a QA plan that most effectively meets their specific needs. Thus, no attempt has been made to determine or define the minimally acceptable QA procedures or requirements.

Section 2.0 of this report outlines the major elements of a QA plan: (1) daily QA checks, (2) periodic QA checks and preventive maintenance, (3) corrective action procedures, and (4) accuracy checks. Procedures that may be included are identified and described for each of the four elements. Recommendations regarding the appropriate procedures for an initial QA plan are also provided. Section 3.0 describes briefly the organization and interaction of the elements of the QA plan. Section 4.0 presents an approach that may be used for the implementation and revision of the QA plan to optimize its usefulness and cost-effectiveness. Section 5.0 provides comments regarding considerations affecting the assignment of the various QA responsibilities at a particular plant. Example QA procedures developed during the opacity CEMS Pilot Project are included in Appendix A and example QA data summaries are included in Appendix B.

2.0 ELEMENTS OF AN OPACITY CEMS QA PLAN

This section describes each of the major elements of an opacity CEMS QA Plan. These elements include: (1) daily QA checks; (2) periodic QA checks and preventive maintenance; (3) corrective action procedures; and (4) accuracy checks. The following discussions describe the nature and types of activities that may be included in each of these elements. The interaction and organization of the above elements are described in Section 3.0 of this report.

2.1 DAILY QA CHECKS

Daily QA check procedures for opacity CEMS's should be developed and implemented to allow for the identification of monitoring problems and, thus, for the timely initiation of corrective action. Adequate daily QA check procedures can be performed from the monitor control unit/data recording location in virtually all cases. The daily check procedures should require only a few minutes per day to complete for each monitoring system, and can be performed by personnel who are not thoroughly familiar with the technical details of the opacity monitoring instrumentation.

The daily QA checks may include the following:

1. Zero and Span Checks - Opacity monitoring regulations require that checks of the zero (or low level) and span drift be performed at least once daily. (Adjustments to the monitoring system are required when the zero or span drift exceed specified limits.) Daily zero and span checks should be included in all opacity CEMS QA plans, since these checks are required by the applicable regulations, and because they provide an overall indication of the performance (i.e., accuracy and precision) of virtually the entire monitoring system.

   The daily check procedures should contain a written procedure for performing the zero and span checks. This procedure should indicate that the determination of zero and span drift be based on the measurements displayed by the permanent data recording system that is used as the basis for preparation of quarterly reports. The zero and span drift check procedure should also specify the criteria that are used to determine when adjustments to the CEMS will be performed.

2. Fault Indicators - Virtually all contemporary opacity CEMS's incorporate fault indicators in the monitor control unit. When activated, the fault indicators warn of monitor malfunctions and/or operating conditions that may affect the quality of the monitoring data. The number and type of fault indicators are monitor-specific and vary both between monitor manufacturers and, in some cases, among the different models provided by the same manufacturer.

   For opacity CEMS's equipped with computerized data recording systems, the software may be designed to provide flags and/or error messages in the computer printout to warn of problems with the monitoring system.

These messages should be considered equivalent to the fault indicators incorporated in the monitor control unit.

It is strongly recommended that a check of all available fault indicators and/or error messages in computer printouts be included in the daily QA check procedures.

3. Auxiliary Monitor Performance Parameters - Some opacity CEMS's provide easy access to important monitor performance parameters, such as reference current values or zero compensation levels, at the monitor control unit. Inclusion of checks of these parameters in the daily QA check procedures allows data to be compiled that can be used to assess both (a) the stability of these parameters and (b) whether the fault indicators for the same parameters are operating reliably. It is recommended that checks of these monitor performance parameters be included in the initial daily check procedures and that the frequency of checking these parameters be subsequently adjusted based on the observed monitor performance.

4. Auxiliary Data Recording/Data Display Devices - Many opacity CEMS's use a computerized data recording system or data logger as the primary data recording system. Most of these CEMS's are also equipped with strip chart recorders that serve either as back-up data recorders or as analog data display devices for use by the boiler operators. In addition, the opacity CEMS control unit usually includes either an analog or a digital panel meter. At some sources, measurements that are used to assess monitor performance are obtained from the panel meter. Therefore, at these sources the accuracy of the panel meter can affect the accuracy of the opacity CEMS data.

   Checks of auxiliary recorders and/or data display devices are important in those cases where (1) back-up recording devices are used during malfunctions of the primary data recording system, or (2) the accuracy of panel meter readings can affect either the determination of the need for adjustment of the CEMS calibration or the accuracy of the CEMS data. Checks of the auxiliary data recording/data display devices can be accomplished by either (1) expanding the daily zero and span check procedures to include evaluation of the responses of the auxiliary devices in addition to the responses of the primary data recorder, or (2) comparison of simultaneous measurements provided by the permanent data recorder and the auxiliary device. It is recommended that such checks be included in the daily QA check procedures until sufficient data are obtained to justify less frequent checks. Alternatively, these checks could be performed only on those occasions when data from auxiliary data recording/data display devices are actually used.

Decisions regarding which of the above parameters should be included in daily QA checks depend on many monitor- and source-specific factors. Among the most important factors to consider are: (1) the design and operational features of the specific opacity monitor, (2) the data recording/data display devices used in the opacity CEMS's, (3) historical monitor performance and previously encountered problems, and (4) zero and span drift adjustment procedures.

Although an attempt should be made to choose the best parameters for the daily checks at the outset, periodic review and revisions of the QA plan (see Section 4.0) will allow for the inclusion of additional parameters and/or for the deletion of unnecessary checks relative to the initially established daily QA check procedures.

At most electric utility generating stations, a number of people will be involved in the performance of the daily QA checks. Therefore, it is extremely important that clear, concise written procedures be developed for the daily QA checks to ensure that all involved personnel will perform them in a consistent manner. It is recommended that a one-page daily log be developed for recording of the necessary data. The daily log can be formatted in a manner that (1) minimizes the recording burden, (2) encourages the consistent recording of data, and (3) clearly delineates the acceptance criteria for the daily checks and whether corrective action is necessary. It is strongly recommended that the daily log require the person performing the daily check to sign or initial the log sheet. Examples of detailed instructions for daily checks and daily log sheets for several opacity monitoring systems are included in Appendix A of this report.

If only a small number of people (i.e., one or two) perform all of the daily QA checks, or after all personnel involved in the daily QA checks have become completely familiar with the data recording procedures and criteria for initiating corrective action, it may be possible to eliminate the daily log and instead substitute a control chart or condensed log. Such a record keeping procedure would allow for summarizing all data from the daily checks during a one-month period on a single log sheet. (Examples of such summaries are included in Appendix B of this report.) It is emphasized that the use of a summary log or control chart will reduce the volume of paper records and will facilitate periodic review of the data; however, in most cases such a log is not as effective as a daily log sheet in requiring consistent recording of data or ensuring the initiation of corrective action when applicable control limits are exceeded.

2.2 PERIODIC QA CHECKS/PREVENTIVE MAINTENANCE

The periodic QA procedures provide for checks of monitoring system components and operational status that are unfeasible, impractical, or unnecessary on a daily basis. These procedures include activities that are only necessary on a semi-frequent basis (e.g., weekly, monthly, or quarterly, etc.), and include checks of the instrumentation at both the actual monitoring location and the control unit/data recording location. The periodic QA checks should be designed to identify developing or existing problems with the opacity CEMS that cannot be detected in the daily checks. The periodic QA procedures should also incorporate preventive or routine maintenance procedures for the opacity CEMS. The nature of the periodic QA procedures requires that personnel who are familiar with the operation, maintenance, and calibration of the opacity CEMS perform these activities. The time required to perform a periodic QA check typically ranges from 2 to 8 hours. The time required may be significantly affected by the difficulty of the access to the monitoring location, the availability of communications between the monitoring location and the control unit location, and the complexity of the monitoring system.

The periodic QA procedures may include the following:

1. Transmissometer Optical Alignment - The optical alignment of the transceiver and reflector components is a critical factor in obtaining accurate effluent opacity measurements. Virtually all contemporary opacity CEMS's provide an optical alignment sight for determining whether the transmissometer components are properly aligned.

   It is recommended that a check of the optical alignment and the recording of the alignment status be included in the periodic QA check procedures.

2. Dust Accumulation on Optical Surfaces - The periodic QA procedures should include some means for estimating the amount of particulate (in terms of apparent opacity) that has accumulated on the exposed optical surfaces of the transmissometer, and should also provide for cleaning of the optical surfaces. A simple method of accomplishing both of these objectives is to record the effluent opacity measurements, clean the transceiver window, and again record the effluent opacity measurements. The procedure is then repeated for the reflector window. The difference between the effluent opacity measurements before and after cleaning of each window provides a rough estimate of the quantity of dust deposited on each window. However, the validity of such determinations may be affected by fluctuations in the actual effluent opacity while the "before" and "after" measurements are being made. Experience has shown that the suggested procedure provides adequate results at sources where significant levels of dust accumulation are encountered (i.e., > 4% opacity) and where the effluent opacity is relatively constant for at least short periods of time. At sources where the levels of dust accumulation are small (i.e., < 2% opacity) and where effluent opacity fluctuations are relatively large, use of the suggested procedure often produces erroneous results. In these cases, the optical surfaces should be cleaned; however, the quantification of dust accumulation can either be omitted or attempted using an alternate approach. For example, reference to the changes in the zero compensation level or the zero check response before and after cleaning will provide a rough estimate of the quantity of dust deposited on the transceiver optics for some opacity CEMS's.

3. Auxiliary Monitor Performance Parameters - For most opacity CEMS's, periodic checks of a few critical operating parameters can be very helpful in the identification of developing or existing monitor problems. The nature and type of such checks is inherently dependent on the design and operational features of the specific opacity monitor. Examples of critical monitor performance parameters include (a) operational status of the automatic gain control circuit for LSI RM41 monitors, (b) lamp reference voltage for Dynatron Model 1100 opacity monitors, and (c) response to the simulated zero opacity condition provided by the calibration test kit (i.e., audit device) for Contraves Model 400 opacity monitors.

It is recommended that checks of critical monitor operating parameters such as those mentioned above and those identified by the monitor manufacturer be included in the periodic QA check procedures. It is also recommended that checks of important monitor performance parameters such as those described in Section 2.1, Item 3 above (i.e., reference current values and zero compensation levels) be included in the periodic QA checks if they are not included in the daily QA checks.

4. Auxiliary Data Recording/Data Display Devices - In addition to the auxiliary data recording devices and control unit panel meters described in Section 2.1, Item 4 above, many opacity monitors are equipped with electronic test meters at the transceiver location which may be used to assess the need for adjustments or as a reference when adjustments are made. It is recognized that at many power plants, instrument technicians ignore these test meters, and instead use digital voltmeters to obtain more accurate and precise electronic measurements than are provided by the installed meters. Checks of installed test meters may be performed by either (a) comparing the meter responses for zero and span checks of the opacity CEMS to the permanent data recorder responses, or (b) comparing the meter response to the responses of an external measurement device (i.e., calibrated digital voltmeter).

It is recommended that the periodic QA procedures include checks of all electronic data display devices (i.e., control unit panel meters and/or test meters at the transceiver location) which are used by station personnel to assess monitor performance. It is also recommended that checks of all auxiliary data recording devices (e.g., strip chart recorders for opacity CEMS's equipped with computerized data acquisition systems or data loggers) be included in the periodic QA procedures.

5. Purge Air System/Shutters - All opacity CEMS's are equipped with purge air systems that are designed to provide a flow of highly filtered ambient air across the exposed optical surfaces of the transmissometer to minimize contamination of these optical surfaces by particulate in the effluent stream. Some opacity CEMS's are also equipped with shutter systems which close in the event of failure of the purge air system. When operating properly, the shutters do not obstruct the transmissometer light beam while the purge air system is operating, and they close when the purge air system provides insufficient air flow to protect the optical surfaces. Typical failures of the purge air system and shutter devices include: (a) plugging of air filters, (b) leaks in the purge air system supply hoses, (c) failure of the air flow sensor to detect insufficient purge air flow, (d) partial or complete closure of the shutters when the purge air system is working properly, and (e) failure of the shutters to close when the purge air system is inoperative. Failure of the purge air system or shutter devices may result in costly damage to the transmissometer components, loss of data, or a high bias in all effluent opacity measurements due to dust accumulation on the exposed optical surfaces.

It is recommended that the periodic QA check procedures include a visual inspection of the purge air system filters and supply hoses, and checks that the shutters do not obstruct the transmissometer light beam during normal operation and that they close when the purge air flow rate is inadequate.

6. Preventive Maintenance - Preventive or routine maintenance procedures are typically specified by the monitor manufacturer in the operator's manual for the monitor. These procedures usually include replacement of measurement lamps, fault lamp bulbs, purge-air filters, and desiccant cartridges. Monitor manufacturers typically specify either a frequency for replacing expendable materials or criteria for determining when such components must be replaced. Operational experience with the opacity monitor may indicate other maintenance activities that should be performed periodically, such as the removal of accumulated material from the transmissometer flanges or sampling ports. Other preventive or routine maintenance activities are necessary to maintain data recording equipment in proper working order. In addition to the maintenance practices specified by the data recorder vendor, common sense requires (a) reasonable cleaning of data recording devices, (b) checks and/or replacement of chart recorder inking supplies or printer ribbons, and (c) replacement of paper supplies as necessary.

   It is recommended that preventive or routine maintenance activities for the opacity monitor either specified by the monitor manufacturer or developed based on operational experience be incorporated into the periodic QA procedures. This approach will ensure that these activities are performed at the same time other checks of monitor operational status are performed, and will therefore minimize additional trips to the monitoring location. To the extent that routine maintenance activities of the data recording equipment are not included in the daily QA checks, it is recommended that these activities also be included in the periodic QA procedures in order to avoid unnecessary CEMS downtime.

Decisions regarding the exact procedures that should be included in the periodic QA procedures depend on monitor- and source-specific factors. In addition, the appropriate frequency for performing the periodic QA procedures is source-specific. Choosing an appropriate frequency requires balancing concerns regarding data quality against the amount of time and effort required to perform the checks. Important factors to consider in this decision are (1) the reliability of previous monitor operation and (2) the difficulty associated with access to the monitoring location. For example, at sources where chronic monitor operational problems have been encountered and where access to the monitoring location is easy, it may be appropriate to conduct periodic QA checks every two weeks, at least initially. In contrast, at sources where the opacity CEMS has operated reliably and where access to the monitoring location is difficult, it may be sufficient to conduct periodic QA checks only once every three or four months.

If no previous monitor operational experience is available upon which to base a decision, it is recommended that the periodic QA checks be performed on a monthly basis during the initial period of the QA plan implementation. Periodic review of the QA data and corresponding revisions to the QA plan (as described in Section 4.0) will allow for appropriate revision of the frequency of QA checks, as well as for the inclusion of additional checks and deletion of unnecessary procedures based on actual monitor performance.

As with the daily QA checks, it is recommended that concise, clearly written procedures should be developed for performing the periodic QA checks to ensure that all involved personnel perform the checks in the same manner, and to ensure that corrective action is initiated when control limits are exceeded. In addition, it is strongly recommended that a periodic QA log be developed and completed for each periodic QA check to provide a record for assessing monitor performance. Periodic QA check logs can be developed that (a) minimize the data recording burden, (b) encourage consistent data recording practices, and (c) clearly indicate when control limits are exceeded, and thus when corrective action is necessary. Example periodic QA check procedures and log sheets for several opacity CEMS's are included in Appendix A of this report.

2.3 CORRECTIVE ACTION PROCEDURES

Control limits must be established for virtually all of the parameters included in either the daily QA check procedures or periodic QA check procedures. (Control limits are not necessary for parameters or measurements recorded for informational purposes only.) Whenever the control limits are exceeded, corrective action activities should be initiated in order to resolve the problem with the opacity CEMS. Corrective action may also be initiated as a result of accuracy checks performed by source personnel or performance audits conducted by the control agency. In general, corrective action procedures and corresponding records should provide documentation of what was wrong with the CEMS, what was done to correct the problem, and performance check results that demonstrate that the problem was actually resolved.

Clearly, corrective action procedures are even more monitor- and source-specific than are the daily and/or periodic QA check procedures. To a large extent, the corrective action procedures are contained in the monitor operator's manual within applicable sections that describe procedures for instrument (a) start-up, (b) calibration, (c) trouble-shooting, and (d) repairs/maintenance. (These procedures can be incorporated into the QA plan simply by reference to the operator's manual.) The corrective action procedures should stress "before" and "after" measurements of appropriate parameters in order to provide a basis for assessment of the impact of repairs and/or adjustments on fault indicators, zero and span check responses, and monitor calibration. In addition, the corrective action procedures should indicate the need for only the measurements, adjustments, and repairs for those components or subsystems of the opacity CEMS necessary to return the entire opacity CEMS to operation within the applicable control limits. For example, if a zero offset develops between the control unit and strip chart recorder (as indicated by the daily QA check), all that would be necessary is (a) recording of the pre-adjustment zero and span reponses, (b) adjustment of the chart recorder calibration, (c) a final zero and span drift check that showed the proper responses for the chart recorder and agreement between the control

unit and chart recorder responses. In contrast, failure of an important electronic component in the transceiver might require a complete recalibration of the opacity monitor, including an off-stack, clear path check (i.e., zero alignment).

It is recommended that a corrective action log be developed and that it be appropriately completed on each occasion that repairs or adjustments are made. A corrective action log satisfies the regulatory requirement for maintaining records of all CEMS adjustments and/or repairs, and also provides a very useful basis for evaluating the effectiveness of repairs and adjustments and for identifying chronic monitor problems. Notes recorded by the person performing the repairs are perhaps most useful, provided that they can be understood by the other personnel who make repairs and adjustments to the monitoring system. At a minimum, it is recommended that the corrective action log provide for recording of the same parameters that are included in the daily and periodic QA checks both before and after adjustments are completed. Examples of corrective action logs for several opacity CEMS's are included in Appendix A of this report.

2.4 ACCURACY CHECKS

As used here, accuracy checks refer to either (a) an on-stack performance audit, or (b) an off-stack (or clear path) zero alignment and calibration check. These accuracy checks are briefly described below.

2.4.1 Performance Audits

Performance audits of an installed opacity CEMS may be conducted by either source personnel or the control agency to assess the operational status of the opacity CEMS and the accuracy and precision of the opacity measurements relative to the simulated zero condition provided by the zero check device. Performance audits do not quantify the absolute accuracy of the opacity measurements.

Performance audit procedures for many contemporary opacity CEMS's are contained in "Performance Audit Procedures for Opacity Monitors" (EPA No. 340/1-83/010). Additional information and suggestions for modifications to the above referenced procedures are contained in "Opacity CEMS Audit Procedure Guidelines," Opacity CEMS Pilot Project Draft Report, March 1985.

In essence, virtually all of the checks included in the referenced audit procedure documents should be included in either the daily or periodic QA checks described in Sections 2.1 and 2.2 of this report, except for the calibration error check. In general, the calibration error check procedure uses an audit device and a set of three calibrated neutral density filters to assess the precision, linearity, and accuracy of the opacity CEMS (relative to the zero check response) at three test points over the measurement range of the monitor. Each of the three test filters is inserted into the light path five times, and the calibration error check result for each filter is calculated in the same manner as the calibration error test results described in Performance Specification 1, Appendix B, 40 CFR 60. (Alternate procedures are used for some monitors.)

Audit devices are commercially available for most opacity CEMS's. Neutral density filters can be obtained from a number of suppliers and calibrated neutral density filters (traceable to the National Bureau of Standards) can also be obtained.

It is recommended that the calibration error check portion of the performance audit procedures be conducted at least once per year for each installed opacity CEMS. The calibration error check should also be performed when there are questions regarding the accuracy or linearity of the opacity data.

2.4.2 Clear Path Calibration - Zero Alignment

For the daily and periodic QA checks and for the performance audit checks, the accuracy of the opacity measurements is determined relative to the monitor's response to the simulated zero check devices. The procedure for establishing the equivalency of the simulated zero check device and the actual clear-path (zero opacity) condition is referred to as "zero alignment." Performance Specification 1 (Appendix B, 40 CFR 60) requires that this procedure be performed either under clear stack conditions or prior to installing the opacity monitor at the measurement location. Since some amount of residual opacity is usually present at the monitoring location even when the source is not operating, the zero alignment procedure is almost always performed prior to the initial installation of the monitor.

Prior to the March 30, 1983 revisions to Performance Specification 1, the regulations required that the clear-path calibration/zero alignment be performed at least once per year. The requirement for the annual check was deleted, since the purpose of the Performance Specification is to ensure the initial capability of the opacity CEMS to provide valid data, rather than to provide QA guidelines.

The frequency for performing a clear-path calibration or zero alignment should be based on the typical rate of change between the simulated zero check response and the true zero check response. However, there is almost no available public information regarding this factor. (One plant that participated in the Opacity CEMS Pilot Project indicated that the zero alignment procedure was performed once per year for each of the four transmissometers installed at that plant.)

It is recommended that a clear-path calibration check be performed once per year or at some other frequency for which there are data supporting the choice of the interval between clear-path calibration/zero alignment checks.

3.0 ORGANIZATION OF QA ACTIVITIES

The four elements of the QA plan for opacity CEMS's are (1) daily QA check procedures, (2) periodic QA check procedures and preventive maintenance, (3) corrective action procedures, and (4) accuracy checks. These four elements include all of the activities necessary for the acquisition of quality assured opacity monitoring data after the monitor has been properly installed and after it has been successfully demonstrated to comply with the requirements of Performance Specification 1 (Appendix B, 40 CFR 60).

One possible arrangement of the four elements of the QA Plan is shown in Figure 1. Other organizational schemes are possible and may be advantageous in certain circumstances. The organization shown in Figure 1 is recommended because it is extremely simple and flexible. The four elements are interconnected only by (1) the schedules for the daily QA checks, periodic QA checks, and accuracy checks, and (2) the criteria for initiating (and completing) corrective action. Changes in the schedules for the periodic QA checks and/or accuracy checks, and changes in the acceptance criteria (control limits) for the three quality assessment activities would not require reorganization of the QA plan.

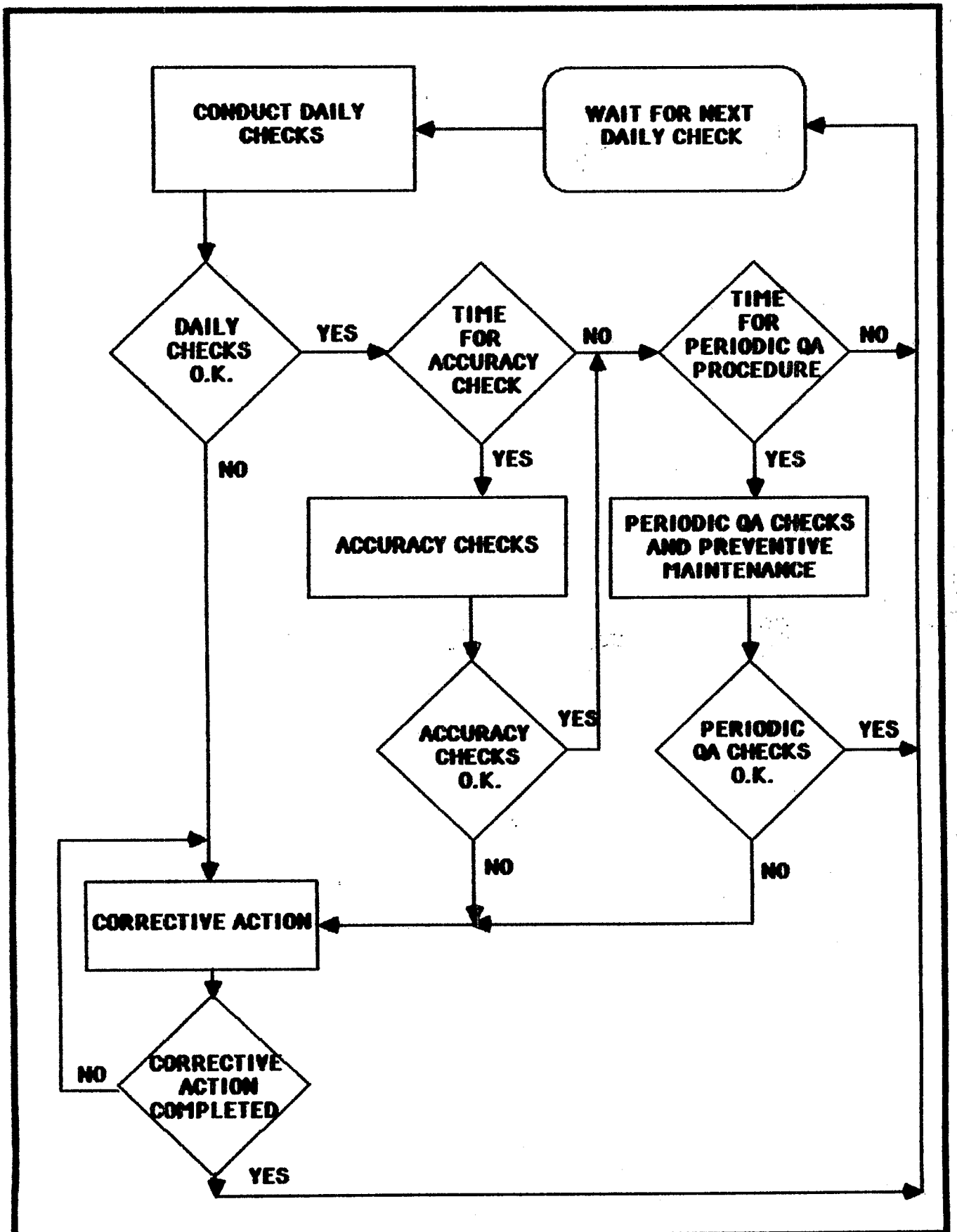


FIGURE 1. ORGANIZATION OF QA ACTIVITIES

4.0 QA PLAN IMPLEMENTATION AND REVISION

The development and implementation of a QA plan for an opacity CEMS is to some extent a trial and error procedure. In most cases, the QA plan that is initially developed should be reviewed from time to time to determine if additional or more frequent activities are necessary to ensure data quality and/or to determine if some of the QA procedures can be relaxed in order to reduce resource expenditures in those cases where the quality of the data is more than adequate. A major QA management goal should be to achieve the desired level of data quality at the lowest real cost. Since opacity CEMS QA plans are inherently monitor- and source-specific, achievement of this goal requires that the QA plan be considered a dynamic rather than a static document.

The major steps in the implementation and revision of a QA plan are shown in Figure 2. These steps are briefly described below.

4.1 ESTABLISH INITIAL QA OBJECTIVES

Management of the QA plan implementation to achieve the necessary level of data quality at the lowest cost requires that the QA objectives be clearly defined. In the most general sense, the quality of the data must be compatible with the intended use of the data. Two potential uses of opacity CEMS data at electric utility plants are: (1) the plant personnel may use the data to identify process and control system problems in order to initiate actions that will maximize efficiency and minimize equipment deteriorization, and (2) the control agency will rely on the data to identify periods of excess emissions in order to prioritize source inspections and/or other follow-up activities. The data quality required by the source will be subject to the conditions imposed by particular generating units and other internal considerations of the utility company. The data quality requirements imposed by a plant's own internal use of the data are considered to be no less rigorous than those imposed by the agency's use of the data.

The use of the opacity CEMS data to identify periods of excess emissions is somewhat dependent on the proximity of the effluent opacity for the particular generating unit under normal operating conditions to the opacity level used to identify periods of excess emissions. Coal-fired electric utility generating units are typically subject to opacity limits in the range of 20% to 40% opacity. For most generating units, the opacity under normal operating conditions is generally well below 20% opacity (regardless of the applicable standard); however, when process or control system problems are encountered, the effluent opacity is often much greater than the standard (e.g., greater than 150 percent of the standard). In these situations, if the overall accuracy of the opacity monitoring data is within $\pm$ 5% opacity, there is little chance that periods of actual excess emission will be overlooked or that periods of operation below the opacity standard will be inadvertently reported as periods of excess emissions due to monitor inaccuracy.

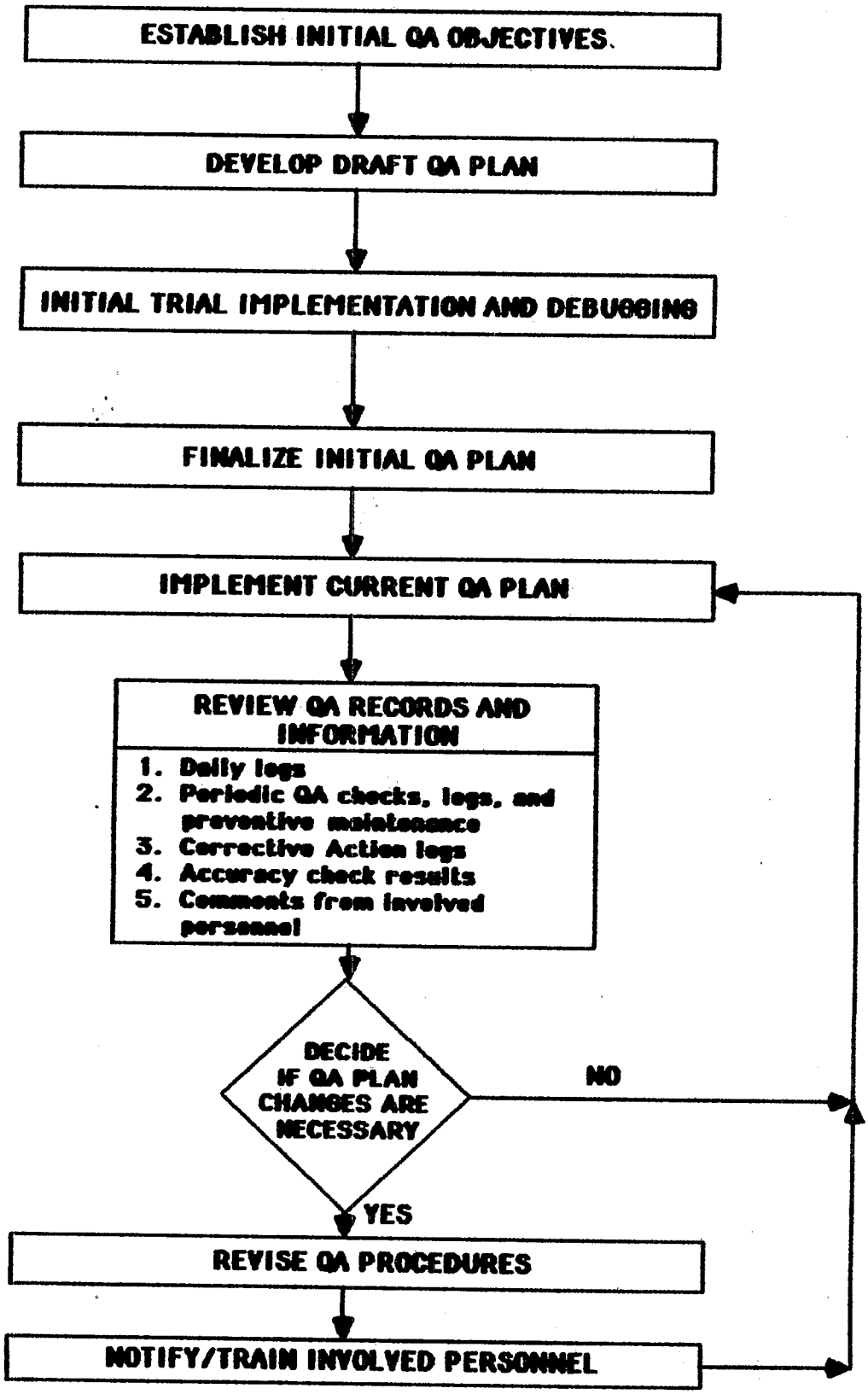


FIGURE 2. QA PLAN IMPLEMENTATION AND REVISION

Using an accuracy of ± 5% opacity as the overall objective, appropriate individual QA objectives (i.e., control limits) can be developed. For example, a particular generating unit might choose the following control limits:

Parameter	Control Limit
Zero Alignment	± 2% opacity
Calibration Error	± 3% opacity
Dust Accumulation	± 2% opacity
Calibration Drift (zero or span drift)	± 2% opacity

Assuming that an opacity CEMS is operating at the maximum for each of the control limits simultaneously (which is grossly pessimistic from the source's perspective), and assuming that the associated biases are randomly distributed (which is optimistic from the source's perspective, since dust accumulation results only in a positive bias), the overall probable error can be calculated. For the above control limits and assumptions, the probable error would be on the order of ± 4.6% opacity. If the calibration drift control limit were increased from ± 2% opacity to ± 4% opacity, then the probable error would be increased from ± 4.6% opacity to approximately ± 5.7% opacity.

The above example analysis is somewhat simplistic from a statistical point of view. Nevertheless, the example shows (1) that overall QA objectives can be established based on considerations of how "good" the data needs to be and (2) how control limits that allow attainment of the overall objectives can be selected.

4.2 DEVELOP DRAFT QA PLAN

The draft QA plan may be developed in accordance with the recommendations provided in Section 2.0. Again, monitor- and source-specific factors and previous operational experience with the opacity CEMS are among the most important factors to consider. The example QA procedures evaluated at four generating stations for Lear Siegler, Dynatron, and Contraves Goerz opacity CEMS's equipped with a variety of data recording systems provide much background information for the development of a draft QA plan. Extensive discussions of these QA plans are contained in "Evaluation of Opacity CEMS Reliability and QA Procedures," Opacity CEMS Pilot Project, Draft Report, April 1985.

4.3 INITIAL TRIAL IMPLEMENTATION AND DEBUGGING

It is recommended that the draft QA procedures be implemented for a short time period in order to identify ambiguous instructions, problems with data logs, and procedures that are simply overly cumbersome. Some of these problems are bound to occur in even the most carefully prepared QA plan. The trial implementation/debugging period should last for several weeks or at least until most of the personnel who will perform the daily QA checks have worked through the instructions and completed the daily log, and at least until one periodic QA check has been performed.

4.4 FINALIZE INITIAL QA PLAN

The problems identified in the initial trial implementation/debugging period must be resolved. The comments of the personnel performing the checks are probably the most useful source of information for revising the instructions and log sheets for each element of the QA plan. It may also be necessary to revise the QA objectives and/or individual control limits at this point in the development of the QA Plan.

4.5 IMPLEMENT CURRENT QA PLAN

After all initial revisions to the QA plan have been completed, the plan should be implemented for at least several months. Implementation of the QA plan for six months will provide sufficient data to allow appropriate adjustments to each of the elements of the QA plan to be made within the same time frame.

4.6 REVIEW OF QA RECORDS AND INFORMATION

At the end of the first implementation period of the initial QA plan, the available QA documentation should be reviewed. This review should include daily QA check logs, periodic QA check results, corrective action records, accuracy check results, and comments from the personnel who have carried out each of these procedures. It is recommended that data from the daily QA checks be consolidated into monthly summaries or control charts to facilitate analysis of data for trends. The objectives of the review and analysis of data are (1) to identify problem areas and/or recurring monitor problems that require additional attention and (2) to identify those parameters that are documented to be very stable and thus, no longer warrant checking at the initially scheduled frequency. Examples of this type of analysis are provided in "Evaluation of Opacity CEMS Reliability and QA Procedures," Opacity CEMS Pilot Project Draft Report, April 1985.

If no changes to the QA plan appear to be necessary, either the review and analysis are too superficial or the QA plan has already reached a maximum cost-effectiveness level. In the latter case, the QA plan should continue to be implemented without changes.

4.7 REVISION OF THE QA PLAN

The QA plan should be revised in accordance with the results of the review and analysis of the QA data from the implementation period. It is important that changes in both the instructions and the QA data logs be made, even though most of the personnel involved with the implementation of the QA procedures will no longer refer to the instructions. (The use of out-dated instructions with revised data sheets can create many problems when personnel changes occur.)

4.8 NOTIFY/TRAIN INVOLVED PERSONNEL

Personnel responsible for the implementation of specific elements of the QA plan must be properly notified of changes in the specific QA procedures. One result of the initial period of QA implementation may be the identification of the need for additional training of specific individuals. If this situation occurs, either the necessary training should be provided or the division of QA responsibilities should be altered to relieve the need for training.

After all involved personnel have been notified of changes in the specific QA procedures and after all training issues have been resolved, implementation of the revised QA plan should begin again at Step 5, "Implement Current QA Plan."

The entire process should be repeated indefinitely; however, the periods between review of the QA documentation may be extended during subsequent implementation periods. Eventually, the most cost-effective QA plan will be developed through iteration.

5.0 ORGANIZATION OF QA RESPONSIBILITIES

The implementation of opacity CEMS QA plans usually involves multiple personnel from several different departments or groups at electric utility generating stations. Therefore, the clear delineation and assignment of the responsibilities for various aspects of the QA plan to different groups and/or individuals, as well as coordination among the different groups and/or individuals, is usually necessary.

The management and organizational structure used for power plant personnel vary among electric utility companies, and may also vary among different generating stations operated by the same company. Union labor agreements differ greatly for different companies. The number of people who may be involved with an opacity monitoring program can vary dramatically among companies and generating stations. Finally, different approaches are often taken by different companies regarding the interaction of corporate environmental representatives and station personnel. All of these factors must be considered in the development and implementation of an opacity CEMS QA plan.

To be successful, an opacity CEMS QA plan must be compatible with the existing management and organizational structure at the generating station. The QA plan should be designed to rely on the established lines of communication and decision making authority among the various groups and/or individuals involved with the opacity monitoring program.

The opacity CEMS QA plan delineated in the preceding sections involves various activities included in the four elements of the QA plan: (1) daily QA checks, (2) periodic QA checks and preventive maintenance, (3) corrective action, and (4) accuracy checks. Decisions regarding the assignment of QA responsibilities should take into account the differences in the technical skills and knowledge required by the specific activities associated with each of the QA plan elements. In essence, the daily QA checks do not require a detailed understanding of how the opacity CEMS works; however, the other three elements do. Another major difference between these two groups of elements is the frequency with which activities are performed. The daily QA checks are obviously performed on a daily basis; the other activities are performed relatively infrequently. Because of these differences, some power plants may assign responsibilities for performing daily QA checks to one group of people and assign the responsibilities for the other activities to a second group. Three of the four generating stations participating in the Opacity CEMS Pilot Project chose this option. (The fourth station assigned responsibility for all of the QA activities to the instrument department personnel.) Of the three stations that divided the QA responsibilities, two stations chose to have the boiler operators perform the daily QA checks; the third station had an individual from the "Results Department" perform the daily QA checks. In all cases, instrument technicians performed the other activities included in the QA plan.

In some cases, a large number of people (10-15 individuals) may be involved in performing the daily QA checks. In this situation, the importance of clear, step-by-step instructions, completion of the daily QA logs, and keeping track of who performed the checks is increased, since verbal communication among all the different individuals is not likely to provide much continuity of operation.

The periodic QA procedures, corrective action activities, and accuracy checks all require that the personnel performing these activities have a working knowledge of how the opacity CEMS works. Usually, these activities will be performed by a relatively small group of individuals whose jobs routinely require effective exchange of information. Thus, the instructions associated with these activities may be less detailed; however, the acceptance criteria should be very clear. In addition, since these elements of the QA plan are performed relatively infrequently and/ or in response to the unpredictable development of problems, communications with other departments or individuals and keeping track of schedules are important.

In addition to the responsibilities associated with the four elements of the QA plan, someone must be assigned the responsibility for overseeing the on-going QA program. The responsibilities associated with this task include making sure that: (1) required activities are performed, (2) data logs are properly completed, and (3) proper decisions are made when exceedances of the established QA control limits occur. This person or group of people may also be responsible for the periodic review of QA data to determine whether an increase or reduction in the frequency for specific QA procedures is appropriate. Ideally, the person responsible for making these decisions would not be involved in performing the specific activities required by the QA plan; however, this is not absolutely necessary.

The person or group responsible for overseeing the implementation of the QA plan should be in contact with those persons responsible for the preparation of the quarterly reports that are submitted to the control agency. This is necessary: (1) to ensure that the correct information regarding CEM performance is included in the report, and (2) to close the feedback loop regarding any response of the control agency to reported CEMS performance data. Finally, the person overseeing the implementation of the QA plan should be in contact with other station personnel and/or corporate personnel who use the CEMS data to ensure that the level of data quality is sufficient for the internal use of the monitoring information.

APPENDIX A.

EXAMPLE QUALITY ASSURANCE PROCEDURES

This Appendix contains quality assurance procedures that were used by the four sources participating in the CEMS Pilot Project. Four separate sets of quality assurance procedures are included which address the monitoring instrumentation provided by three major CEMS manufacturers and the source-specific constraints encountered at each of the four participating sources. (All company and plant names and other identifiers have been deleted.) Additional information regarding these QA procedures may be found in "Evaluation of Opacity CEMS Reliability and QA Procedures," CEMS Pilot Project Report, March 1986.

EXAMPLE A

_____ STATION

OPACITY MONITOR QUALITY ASSURANCE PROCEDURES

, STATION

DYNATRON MODEL 1100 OPACITY MONITORING SYSTEMS

OVERVIEW OF QA PROCEDURES

A proposed quality assurance program has been developed for the Station opacity monitoring systems. The specific QA procedures have been developed to be compatible with the Station (1) opacity monitoring instrumentation and monitoring system configuration, (2) data recording devices, (3) effluent handling system, and (4) management and organizational structure. The proposed QA program will be field-tested during implementation, reviewed and evaluated periodically, and revised as necessary over a one-year period. Through this process, it is expected that QA procedures will be developed and demonstrated which are both adequate for maintaining high levels of data quality and cost effective in terms of necessary time and material resource expenditures.

The following elements are included in the proposed Station opacity monitor quality assurance program.

(1) Daily Log, Daily Check Instructions - The Daily Log is to be completed by the personnel responsible for checking the monitoring system on a daily basis. Step-by-step Daily Check Instructions are provided for completing the Daily Log. The Daily Check and Daily Log do not require extensive time to complete, nor do they require that the person performing the procedure be intimately familiar with the opacity monitoring instrumentation. The Daily Check and Daily Log provide for identification of monitoring problems and initiation of corrective action.

(2) Corrective Action Log and Instructions - The Corrective Action Instructions and Log are used when adjustment, repairs, and/or other non-routine corrective action is necessary as indicated by the Daily Checks. The Corrective Action procedures are to be utilized by technical personnel experienced in resolving problems with the monitoring systems. The specific corrective action procedures are relatively extensive, but will provide adequate documentation for future refinement of QA procedures and demonstration of their effectiveness. The corrective action procedures are utilized only on an "as necessary" basis.

(3) Periodic QA Check and Instructions - The Periodic QA check is intended to be performed in conjunction with the opacity monitor routine maintenance program performed monthly at the Station. The Periodic QA Check procedures provide for checks of monitoring system components and operating status which are unfeasible, impractical, and unnecessary on a daily basis.

(4) The documentation of the QA program will be reviewed periodically to determine if modification to the proposed procedures are appropriate. Such modifications may be made as additional experience and data are obtained.

STATION

DAILY CHECK INSTRUCTIONS

DYNATRON MODEL 1100 OPACITY MONITORING SYSTEMS

The following are step-by-step instructions for conducting the Daily Check of the Station Unit # and Unit # opacity monitoring systems. Criteria are provided for determining when corrective action should be initiated. The person conducting the Daily Check of each monitoring system should complete all blanks on the Daily Log as indicated below. (Separate forms are used for the Unit #4 and #5 monitoring systems.)

I. GENERAL INFORMATION

- Enter name of person performing check, the date (month, day, year), and the time of day (24-hour clock) that the check is begun.
- Hours Boiler Down - Enter the number of hours the boiler was not in operation (i.e., not combusting fuel) during the preceding 24-hour period.
- Hours Monitor Down - Enter the number of hours the monitor did not provide a record of effluent opacity during the preceding 24-hour period. Describe monitor downtime in "Comments" section (i.e., cause of outage, time began, time ended, and any corrective action taken to return monitor to service).

II. FAULT LAMPS

- Examine the fault lamps on the Control Unit. Check the appropriate box on the Daily Log to indicate the status of each fault lamp (check "YES" if lamp is illuminated).
- If any fault lamps are illuminated, corrective action should be initiated as soon as possible.

III. ZERO/SPAN CHECK DATA

- Examine the strip chart to determine the zero and span responses of the most recent monitor calibration. Record the zero and span calibration values on the Daily Log in units of % opacity.
- Examine the data logger tape to determine the zero and span response of the most recent monitor calibration, and record these values on the Daily Log.
- Check the appropriate boxes on the Daily Log to indicate whether the zero and span values are outside acceptable limits.
- Check the data logger tape to determine if the proper time of day is displayed. Reset the timer of the data logger if necessary.

Note: IF YES ANSWERS ARE INDICATED FOR ANY OF THE QUESTIONS ON THE DAILY LOG, CORRECTIVE ACTION SHOULD BE INITIATED AS SOON AS POSSIBLE.

IV. COMMENTS

- o Describe any problems observed during the performance of the Daily Check and/or any other apparent problems which may affect monitor performance.
- o ENTER THE TIME OF DAY THAT THE DAILY CHECK IS COMPLETER (PART I).

Opacity Monitoring System

DAILY LOG

STATION UNIT:_____

I. GENERAL INFORMATION

Name:_____ Date: _____ Time Start: _____
Time Complete:_____

Hours Boiler Down: _____ Hours Monitor Down: _____

II. FAULT LAMPS

FAULT LAMPS ON?	NO	YES
Lamp		
Window		
Air Flow		

III. ZERO/SPAN CHECK DATA

Chart Recorder, Zero Value:_____ Span Value:_____
Data Logger, Zero Value: _____ Span Value:_____

	NO	YES
Does Zero Value exceed acceptable limits of ± 2% opacity?		
Does Span Value exceed acceptable limits of ± 2% opacity?		

	Correct	Incorrect
Data Logger Timer		

IF YES ANSWERS ARE INDICATED FOR ANY OF THE ABOVE QUESTIONS, CORRECTIVE ACTION SHOULD BE INITIATED AS SOON AS POSSIBLE.

IV. COMMENTS:

STATION

PERIODIC QUALITY ASSURANCE CHECK INSTRUCTIONS
DYNATRON OPACITY MONITORING SYSTEM

The following are step-by-step instructions for performing the Periodic QA Checks of the Station opacity monitoring systems. Initially, the Periodic QA Checks are to be performed once per month. The person performing the monthly checks should complete all blanks on the Periodic QA Check Log. (A separate data form should be used for each monitor.) The manufacturer's instructions for cleaning optical surfaces, performing electronic adjustments, and inspecting/servicing the purge-air system should be followed throughout the Periodic QA Check.

I. GENERAL INFORMATION

- Enter the Unit number for the monitor on the QA Log.
- Enter the name of the person performing the check, the date (month, day, year), and the time of day (24-hour clock) that the check is begun.

II. CALIBRATION CHECK DATA

(1) Place the "CYCLE TIME HOURS" knob on the "MANUAL POSITION." Rotate the "METER DISPLAY" knob to the "OPACITY" position. Depress "ZERO/SPAN" switch and record the low range calibration check responses of the panel meter chart recorder, and data logger (% opacity).

(2) Record the high range calibration check responses of the panel meter, chart recorder, and data logger (% opacity).

(3) Corrective action should be initiated if all "zero" and "span" responses are not within $\pm$ 2% opacity of the proper values. A Corrective Action Log should be completed if such action is necessary.

(4) Using an accurate volt meter, measure the Lamp Reference voltage from available test points on the back of the control unit. Record the voltage on the QA log. If the Lamp Reference voltage is outside the range of 6.5 $\pm$ 1.0 volts, adjust the monitor according to the manufacturer's instructions and record the post-adjustment Lamp Voltage on the data sheet.

(5) Record the minimum 6-minute average opacity indicated by the chart recorder for the hour preceding the QA check.

III. TRANSMISSOMETER CHECK/SERVICE

This segment of the Periodic QA Check requires that effluent opacity measurements "before and after" both alignment adjustments and cleaning of

optical windows be obtained in order to assess the impact of these activities. These measurements may be obtained by two methods: (1) have an assistant record real-time data if two-way communication between the control unit and monitoring location is available, or (2) sychronize watch and chart recorder, and note the exact time each action is performed to facilitate recovery of opacity measurements from the chart recorder after the various activities are completed.

(1) Alignment Check - Determine the optical alignment status of the transceiver and reflector components by looking through the alignment sight on the transceiver and observing whether the image is within the circular target (acceptable), or outside the circular target (unacceptable). Indicate the position of the light beam on the diagram, and check the appropriate box for alignment status on the QA Log.

If the optical alignment is unacceptable, note the effluent opacity, and then realign the opacity monitoring system in accordance with the manufacturer's instructions. Record the effluent opacity after realignment is completed. If a shift in the baseline opacity occurs after realignment, note the magnitude of the change which was observed in "Part V COMMENTS."

(2) Reflector Window Check - Record the exact time (or effluent opacity) prior to cleaning the reflector optics. Remove the protective window (slide) from the reflector and clean the glass according to the manufacturer's instructions. Replace the reflector protective window. Record the exact time, and wait at least two full integration periods before performing the next step, (or record directly the effluent opacity).

(3) Transceiver Window Cleaning/Check - Record the exact time (or effluent opacity) prior to cleaning the transceiver optics. Remove the protective window (slide) from the transceiver and clean the glass according to the manufacturer's instructions. Replace the transceiver protective window and record the exact time, (or record the effluent opacity).

(4) Purge Air Service - Inspect and service, as necessary, the purge-air blowers, air filters, and shutter mechanism as per the manufacturer's instructions. Note any corrective action taken on the QA Log.

IV. FINAL MEASUREMENTS

(1) If necessary, examine the data record to obtain the average opacity values corresponding to the times recorded on the data sheet (i.e., before and after alignment adjustments, before and after cleaning of the reflector window, and before and after cleaning of the transceiver window). Record all data on the QA Log.

(2) Record the minimum 6-minute average effluent opacity value during the hour period following completion of all adjustments, repairs, and service for the monitor.

(3) Note periods of alignment adjustment and window cleaning on the permanent data record to ensure that these periods will not be later mistaken for excess emissions. Reset alarms if activated during QA checks. Note that the periodic QA check was performed in the "Part V COMMENTS" section of the Daily Log.

V. COMMENTS

All observations regarding monitor performance should be detailed and explained.

ENTER TIME OF DAY PERIODIC QA CHECK IS COMPLETED (PART 1).

Opacity Monitoring System

PERIODIC QA CHECK

STATION UNIT:_____

I. GENERAL INFORMATION

Name:_____ Date:_____ Time Start:_____
Time Complete:_____

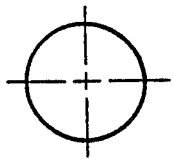
II. CALIBRATION CHECK DATA

	% Opacity		
	Panel Meter	Chart Recorder	Data Logger
(1) Low Range Response			
(2) High Range Response			
(3) Adjusted Low Range Response			
(4) Adjusted High Range Response			

Lamp Reference Voltage:_____ Adjusted Lamp Reference Voltage:_____

Minimum 6-min. opacity value (hour preceding QA check):_____

III. TRANSMISSOMETER CHECK/SERVICE



1. Alignment Status (Note position of light beam on diagram)

	YES	NO
Alignment Acceptable?		

See instructions if alignment is not acceptable

		TIME	EFFLUENT OPACITY
2.	Before reflector cleaning		
	After reflector cleaning		
3.	Before transceiver cleaning		
	After tranceiver cleaning		

IV. FINAL MEASUREMENTS

Minimum 6-min. opacity value (hour following QA Check):_____

V. COMMENTS:

STATION

CORRECTIVE ACTION INSTRUCTIONS
DYNATRON OPACITY MONITORING SYSTEM

The following are step-by-step instructions for completing the Corrective Action Log when adjustments and/or repairs of either the Unit # or Unit # opacity monitoring systems are necessary. The person performing the corrective action should complete all blanks on the Corrective Action Log as indicated below.

I. GENERAL INFORMATION

- o Enter the Unit number corresponding to the monitor for which repairs or adjustments are performed.
- o Enter the name of person performing repairs or adjustments, the date (month, day, year), and the time of day (24-hour clock) that the corrective action is initiated.

II. FAULT LAMPS

- o Enter "ON" or "OFF" for each fault lamp on the Log.
- o Monitor calibration and completion of Part III of the Log are not required if an Air Flow problem initiates the Corrective Action. However, if the "WINDOW," or "LAMP" fault lamps are illuminated, data listed below must be obtained prior to adjusting the monitor.
- o If "LAMP" is illuminated, (1) measure and record the lamp reference voltage, (2) adjust reference voltage to manufacturer's specifications, and (3) record the post-adjustment reference voltage.
- o If "WINDOW" is illuminated, (1) record the effluent opacity indicated by the data recorder, (2) clean transceiver and reflector windows, and (3) record the effluent opacity indicated by the data recorder.
- o Record the time when the fault is corrected. Describe all corrective action taken in the "Part IV COMMENTS."

III. CALIBRATION DATA/ADJUSTMENTS

(1) Place the "CYCLE TIME HOURS" knob on the "MANUAL POSITION." Rotate the "METER DISPLAY" knob to the "OPACITY" position. Depress "ZERO/SPAN" switch and record the low range calibration check responses of the panel meter, chart recorder, and data logger (% opacity).

(2) Record the high range calibration check responses of the panel meter, chart recorder, and data logger (% opacity).

(3) Adjustment of the monitoring system is necessary when the low range check responses of the panel meter, chart recorder or data logger exceed $\pm$ 2% opacity from the correct low range check value. (Correct value of the low range check should be labeled on the front cover of the control unit.)

If no adjustment is made, enter "NA" on line 3 of the Corrective Action Log, and proceed to step (4).

Describe all adjustments and/or corrective action in "Part IV COMMENTS." After all adjustments are completed, repeat step (1) above, and record the post-adjustment low range responses on line 3 of Log.

(4) Adjustment of the monitor is necessary if the high range responses of either the panel meter, chart recorder, or data logger exceed ± 2% opacity from the correct value. (Correct value of the high range check should be labeled on front of control unit.)

If no adjustment is made, enter "NA" on line 4 of the Log. Describe all adjustments and/or corrective action in "Part IV COMMENTS." After all adjustments are completed, repeat steps (1) and (2) above, and record post-adjustment span response on line 4 of Log.

IV. COMMENTS

All repairs and/or adjustments performed as a result of the above procedures should be described. Sufficient explanation should be provided to determine what was done and what effect it had on monitor performance.

In addition, any preventive or non-routine maintenance performed on the monitor should be detailed in this section.

ENTER TIME OF DAY ALL CORRECTIVE ACTION IS COMPLETED. (Part I)

Opacity Monitoring System

CORRECTIVE ACTION LOG

STATION UNIT:_____

I. GENERAL INFORMATION

Name:_____ Date: _____ Time Start: _____
Time Complete:_____

II. SYSTEM/MONITOR FAULTS

FAULT LAMPS	ON/OFF	DATE/TIME CORRECTED
LAMP		
WINDOW		
AIR FLOW		

"LAMP" ON Lamp Voltage - before adjustment:_____ after adjustment:_____
"WINDOW" ON Recorded Opacity - before cleaning:_____ after cleaning:_____

III. CALIBRATION DATA/ADJUSTMENT

		% Opacity		
		Panel Meter	Chart Recorder	Data Logger
(1)	Low Range Response			
(2)	High Range Response			
(3)	Adjusted Low Range Response			
(4)	Adjusted High Range Response			

IV. COMMENTS

EXAMPLE B

_____ STATION

STATION

DAILY CHECK INSTRUCTIONS

LSI OPACITY MONITORING SYSTEM

* RM41 Transmissometers
* 622 Emission Monitor Combiner and Chart Recorder
* DP-30 Data Logger and Printer

The following are step-by-step instructions for conducting the Daily Check of the Station Unit #1 and Unit #2 opacity monitoring systems. Criteria are provided for determining when corrective action should be initiated. The person conducting the Daily Check of each monitoring system should complete all blanks on the Daily Log as indicated below. (Separate forms are used for the Unit #1 and #2 monitoring systems.)

I. GENERAL INFORMATION

* Enter name of person performing check, the date (month, day, year), the time of day (24-hour clock) that the check is begun, and the total boiler O.O.S time for the previous 24 hours.

II. COMBINER DATA

* Examine the fault lamps on the Combiner. Check the appropriate box on the Daily Log to indicate the status of each fault lamp (check "YES" if lamp is illuminated).

* Rotate the Measurement switch to the "COMP" position. Rotate the Analyzer switch to position (1) and record the zero compensation level for Monitor A. The panel meter readout is in units of optical density (OD). Rotate the Analyzer switch to position (2) and record the zero compensation level for monitor B. Return the ANALYZER switch to the "EXIT" position and return the Measurement switch to the "30% OPACITY" position.

* Examine the strip chart to determine the zero and span responses of the most recent monitor calibration. Record the zero and span calibration values on the Daily Log in units of % opacity. The zero and span calibration comes in every 4 hours.

III. DP-30 HOURLY REPORT DATA

* Record on the Daily Log the zero and span values displayed on the most recent Hourly Report.

* Check the appropriate box on the Daily Log to indicate whether the zero and span values are outside acceptable limits.

* Circle on the Daily Log the Reason Code and/or Flags which appear on the most recent Hourly Report.

* Check the appropriate box on the Daily Log to indicate whether the "M" or "R" Flags are present.

* Check the appropriate box on the Daily Log to indicate whether the listed error messages are shown on the Hourly Report.

NOTE: IF YES ANSWERS ARE INDICATED FOR ANY OF THE QUESTIONS ON THE DAILY LOG, A JOB REQUISITION MUST BE INITIATED.

IV. COMMENTS

* If a J.R. is required, enter J.R. number in space provided.*

* Describe any problems observed during the performance of the Daily Check and/or any other apparent problems which may affect monitor performance.

* Enter the TIME OF DAY that the Daily Check is completed.

(*JR means "job requisition")

Opacity Monitoring System

DAILY LOG

CO. STATION UNIT:

I. GENERAL INFORMATION

Name:_____ Date: - - 83 Time Start: _____

TOTAL BOILER O.O.S. TIME (PREVIOUS 24 HOURS): _____

II. COMBINER DATA

FAULT LAMPS ON?	NO	YES
Filter		
Shutter		
Ref		
Windows		
Over Range		

Zero Compensation Level: Monitor A COMP (OD):_____ Monitor B COMP (OD):_____

Chart Recorder, Zero Value: _____ Span Value:_____

III. DP-30 HOURLY REPORT DATA

Zero Calibration: _____ Span Calibration: _____

	NO	YES
Does zero value exceed acceptable limits of ± 2.5% opacity?		
Does span value exceed acceptable limits (67.5% to 72.5% opacity)?		

Reason Code/Flags (Circle those present on hourly report)

* D M R A

	NO	YES
Is the "M" or "R" Flag present?		

	NO	YES
Error Messages on Hourly Report?		

1. A/D REFERENCE FAULT
2. DIGITAL/ANALOG DIFFERENTIAL ALARM
3. A/D TIME OUT

IF YES ANSWERS ARE INDICATED FOR ANY OF THE ABOVE QUESTIONS, A JOB REQUISITION SHOULD BE INITIATED

IV. COMMENTS: J.R. No. _____ was initiated

TIME COMPLETED: _____

Route: Operating Engineer
File 4/13/26(d)

SP-192

JOB INSTRUCTION BREAK-DOWN (J.I.B.)

Job Periodic QA Check J.I.B. No. 1-13-5.1

Prepared by _____ Date 6-15-83 1-10-79 Job Class. Tech.

The following are step-by-step instructions for performing the Periodic QA checks of the Station opacity monitoring systems. The Periodic QA checks are to be performed at least once per month. The person performing the monthly checks should complete the Periodic QA Check Log. (A separate data form should be used for each monitor.)

I. General Information

* Enter the Unit number (1 or 2) and the monitor indentifier (A or B).

* Enter the name of the person performing the check, the date (month, day, year), and the time of day (24-hour clock) that the check is begun.

II. Calibration Check Data

(1) Enter PA/PD commands at the DP-30 printer to initiate display of instantaneous analog and digital computer values at one-minute intervals for the monitor being evaluated.

Example: Control is gained by pressing the CTL and I keys simultaneously. The DP-30 system response and the operator response should be as follows:

System Response	Enter	System Response	Enter
DP-3Ø I/O REQ			
STACK ID?	1 (or 2)	1 (or 2)	Return
?/1 (or 2)	P A	PA	Return
?/1 (or 2)	P D	PD	Return
?/1 (or 2)	Return		

(2) Rotate the Analyzer switch on the combiner to the position corresponding to the monitor being evaluated. Position 1 corresponds to the A monitor and position 2 corresponds to the B monitor. Rotate the measurement switch to the "REF" position and record the reference current value (ma) on the Log. Return the Analyzer switch to the "EXIT" position and the Measurement switch to the "30% Opacity" position.

(3) Switch the monitor (duct) not being evaluted out-of-service at the Combiner and initiate a manual zero calibration. Record the zero calibration responses of the panel meter and strip chart recorder. Record the analog system zero calibration response from the DP-30 printout (see sample DP-30 printout sheet attached).

(4) Rotate the Analyzer switch to the position corresponding to the monitor being evaluated. Rotate the Measurement switch to the "COMP" position and record the zero compensation value indicated by the panel meter. Return the Analyzer switch to the "EXIT" position and the Measurement switch to the "100% Opacity" position.

(5) Initiate a span calibration check and record the panel meter and strip chart responses on the Log. Record the analog system span response from the DP-30 printout.

(6) Record the minimum 6-minute average opacity indicated by the chart recorder and DP-30 printout for the hour preceding this check.

(7) Switch the out-of-service monitor (duct) back to operate.

(8) Repeat steps 2 through 7 for the monitor (duct) which was previously taken O.O.S. Be sure to use a separate form.

(9) Return the combiner unit back to normal operation, that is...

* "Operate" light illuminated
* Measurement switch in the "30% Opacity" position
* Analyzer switch in the "Exit" position.

(10) Reissue the PA/PD command to stop the DP-30 printout.

Example: Control is gained by pressing CTL and I keys simultaneously. The DP-30 system response and the operator response should be as follows:

System Response	Enter	System Response	Enter
DP-3Ø REQ			
STACK ID?	1 (or 2)	1 (or 2)	Return
?/1 (or 2)	P A	PA	Return
?/1 (or 2)	P D	PD	Return
?/1 (or 2)	P D	PD	Return
?/1 (or 2)	Return		

III. Transmissometer Check/Service

All the time spent performing this procedure on each instrument is counted as out-of-service hours. It is very important that this job be done as quickly and as thoroughly as possible so the system remains as continuous and trouble free as possible.

(1) In the Control Room:

Before starting to work on any monitor, transceiver, and/or reflector, log that particular monitor out-of-service with the "OS" commands. It is suggested that both monitors be taken O.O.S. before preceeding out to the field in order to save time.

Example: Control is gained by pressing the CTL and I keys simultaneously. The DP-30 system response and the operator response should be as follows:

System Response	Enter	System Response	Enter
DP-3Ø REQ			
STACK ID?	1 (or 2)	1 (or 2)	Return
?/1 (or 2)	O S	OS	Return
INSTRUMENT?	M O N A	M O N A	Return
?/1 (or 2)	O S	OS	Return
INSTRUMENT?	M O N B	M O N B	Return
?/1 (or 2)	Return		

NOTE: Both field monitors cannot be taken O.O.S. on the same instruction line, that is, "MONA and MONB" is not a valid entry and will result in the computer issuing the instruction "BAD ENTRY".

(2) At the Reflector:

A. Remove, empty, and wipe clean with a rag, the pre-cleaner collector.

B. Remove, empty, and wipe clean with a rag, the pre-filter collector.

C. Remove and inspect the filter element and replace it with a new or clean one.

NOTE: These filter elements can be cleaned and several times before a new one is needed by following the instructions on the blower housing.

D. After cleaning, inspect the filter by dropping a light down inside the element. If any ruptures or pin holes are observed, discard and use a new element.

E. Replace the filter element and the pre-filter collector only.

F. Before replacing the pre-cleaner collector, place your hand over the intake to completely obstruct air flow.

* Check to see that the shutter falls.

* Check that the "shutter" and "filter" alarms occur, on the combiner panel in the Control Room, for that particular duct by positioning the analyzer switch.

G. Replace the pre-cleaning collector.

H. Restore the shutter to the open position by de-energizing the blower motor and then re-energizing it again.

NOTE: If shutter fails to open after the above procedure, the shutter solenoid or T.D. relay may be faulty. Replace the defective part and try the above procedure again.

I. Inspect all air hoses for mechanical integrity. Test all hose clamps for tightness.

J. Clean the reflector lens completely by removing the iris plate and wiping with the clean, dry, lint free cloth stored inside the cylinder located in the reflector mounting flange.

K. If any moisture, small beads, are present within the reflector (between glass cover and reflector) then the dessicant cartridge should be changed.

NOTE: Be sure the reflector module is replaced in the exact 3-hole position found, when changing dessicant.

L. Inspect the duct mounting flange for any accumulation of dust. Rod out any accumulation with wire brush rods.

M. Close up the reflector unit.

N. Perform an alignment check at the reflector by determining if the light beam is within the circular target of the viewing port. Indicate the position of the image within the circular target on the diagram and check the appropriate box for alignment status on the QA Log.

(3) At the Transceiver:

A. Repeat Steps 2-A through 2-I.

B. Clean the projection lens and the zero mirror face with the clean, dry, lint free lens cloth by positioning the mode switch from "Operate" to "Zero".

C. Return the mode switch back to "Operate" position. Be sure the zero mirror returns to the rest (down) position.

Do not change mode switch from "Operate" again until zero mirror cam comes to rest.

D. If any moisture, small bead, are present on the inside of the projection lens, the dessicant cartridge should be changed.

E. Inspect the duct mounting flange for any dust accumulation. Rod out any dust with wire brush rods.

F. Close up the transceiver unit.

G. Check the AGC LED (Automatic Gain Control light emitting diode) on the right hand side of the transceiver, and record whether it is "ON" or "OFF".

If the AGC is not on, repairs to the monitoring system must be completed before continuing.

H. Perform an alignment check by removing the plastic cover from the mode switch on the transceiver and turn the switch to the "ALIGN" position. Determine the optical alignment status of the transceiver and retroreflector by looking through the "bull's eye" and observing whether the image is within the circular target (acceptable), or outside the circular target (unacceptable). Indicate the position of the light beam on the diagram, and check the appropriate box for alignment status on the QA Log.

Return the transceiver to the "OPER" position.

* If the optical alignment is unacceptable, realign the opacity monitoring system in accordance with the manufacturer's instructions. If a shift in the baseline opacity occurs after realignment, note the magnitude of the chance which was observed in "Part V Comments".

I. Repeat the above instructions for the other field monitor starting at step number 2.

(4) In the Control Room:

A. At the combiner unit make a manual "zero" calibration (1 minute) and a manual "span" calibration (1 minute).

B. Issue the "IS" command to stop the DP-30 printout.

Example: Control is gained by pressing CTL and I keys simultaneously. The DP-30 system response and the operator response should be as follows:

System Response	Enter	System Response	Enter
DP-3Ø I/O REQ			
STACK ID?	1 (or 2)	1 (or 2)	Return
?/1 (or 2)	I S	IS	Return
INSTRUMENT?	M O N A	M O N A	Return
?/1 (or 2)	I S	IS	Return
INSTRUMENT?	M O N B	M O N B	Return
?/1 (or 2)	See step C		

C. Using the "AC" command type in the following comment for the particular stack:

"QA" MAINTENANCE FOLLOW-UP"

Example:

System Response	Enter	System Response	Enter
	A C	AC	Return
"COMMENT IS"	Type in the above comment	System will print out comment entered	Return
?/1 (or 2)	Return		

IV. Final Measurements

(1) Upon completion of all the above steps, record the minimum 6-minute average effluent opacity value during the hour period following completion of all adjustments, repairs, and service for the monitor.

(2) Record the final zero compensation value for such monitor using the procedure detailed in Part II Step (4) above.

(3) Write a J.R. for any problems that cannot be immediately corrected. Write comments on the QA Log about the nature of the problems.

(4) Write down the time on the QA Log when this procedure is completed.

Opacity Monitoring System

PERIODIC QA CHECK

STATION

I. CO.

UNIT _____ MONITOR _____
Name _____ Date: - - 83 Time Start: _____

II. CALIBRATION CHECK DATA

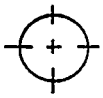
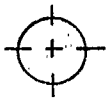
	Panel Meter	Chart Recorder	DP-30 (Analog)
Reference Current (ma)		//////////	//////////
Zero Value (% opacity)			
Zero compensation (OD)		//////////	//////////
Span value (% opacity)			
Minimum 6-min. average opacity value for preceding hour	//////////////		

III. TRANSMISSOMETER CHECK/SERVICE

	YES	NO
1. AGC ON?		

(See Instructions if AGC is not on.

2. Alignment Status (Note position of Light Beam on Diagram)

Transceiver  Retroreflector 

Alignment Acceptable?	YES	NO
Transceiver		
Retroreflector		

(See Instructions if alignment is not acceptable.)

IV. FINAL MEASUREMENTS

1. Minimum 6-min. average effluent opacity during hour: _____
2. Final Zero Compensation value (panel meter, OD): _____

V. COMMENTS:

Time Completed: _____

Route: Operating Engineer

SAMPLE DP-30 PRINTOUT - PA/PD

COMMAND - QA PERIODIC CHECK

Analog System Response Zero or Span (% Opacity)

```
STACK #  1

ADRS. Ø2/Ø     3.88        Ø.36 VOLTS
ADRS. Ø2/1     3.8Ø        Ø.97 VOLTS
ADRS. Ø2/2        1.Ø2 VOLTS
ADRS. Ø2/3        Ø.95 VOLTS
ADRS. Ø2/4        1.Ø1 VOLTS
ADRS. Ø2/7        1.ØØ VOLTS
STACK #  1
ADRS. ØØ       Ø1ØØØ1ØØØØØØØØØØ
```

JOB INSTRUCTION BREAK-DOWN

Job CORRECTIVE ACTION LOG INSTRUCTIONS J.I.B. No. 1-13-5.3

Lear-Siegler RM41 Opacity Monitoring System

Prepared by _____ Date _____ Job Class. _____

The following are step-by-step instructions for completing the CORRECTIVE ACTION LOG when adjustments and/or repairs of either the Unit #1 or Unit #2 opacity monitoring system are necessary. The persons performing the corrective action should complete all blanks on the CORRECTIVE ACTION LOG as indicated below.

I. GENERAL INFORMATION

*Enter the date, plant and unit number corresponding to the monitoring system for which repairs or adjustments are performed, and the number of the job requisition that initiated the corrective action.

*Enter the name of the technician performing the repair or adjustment and the time started.

II. DESCRIBE SYSTEM PROBLEM

Describe the system problem in as much detail as necessary to clearly state the as found condition, to include meter readings, fault lamps, calibration data, etc. Use the reverse side of the CORRECTIVE ACTION if necessary. Refer to the DAILY LOG which initiated corrective action.

III. DESCRIBE ALL CORRECTIVE ACTION TAKEN

Describe all the corrective action taken, in as much detail as necessary to clearly state the repairs or adjustments or other actions taken. Reference and attach all data sheets, DP-30 handcopy, calculations, etc. which resulted from this corrective action.

IV. RECORD TIME AND DATE CORRECTIVE ACTION WAS COMPLETED

Record the time and date when the corrective action was completed, i.e. when the system is again considered operational.

V. THE NEXT DP-30 HOURLY REPORT DATA

Hand carry the CORRECTIVE ACTION LOG to the UCO responsible for the affected generating unit. Notify the UCO that the opacity monitoring system is again operational and that it will be necessary for the UCO to obtain certain information from that unit's NEXT hourly opacity report generated by the DP-30 terminal. Perform the following:

*On the CORRECTIVE ACTION LOG, record the zero and span calibration values printed on the next Hourly Report.

*Check the appropriate box on the CORRECTIVE ACTION LOG to indicate whether the zero and span values are outside acceptable limits.

*On the CORRECTIVE ACTION LOG, circle the Reason Code and/or Flags which appear on the next Hourly Report.

*Check the appropriate box on the CORRECTIVE ACTION LOG to indicate whether the "M" or "R" Flags are present.

*Check the appropriate box on the CORRECTIVE ACTION LOG to indicate whether the listed error messages are shown on the Hourly Report.

NOTE: IF YES ANSWERS ARE INCIATED FOR ANY OF THE QUESTIONS, A JOB REQUISITION MUST BE INITIATED.

VI. COMMENTS

*If a J.R. is required, enter the J.R. number in space provided.

*UCO to route completed CORRECTIVE ACTION LOG as indicated at the bottom of the LOG.

Opacity Monitoring System

CORRECTIVE ACTION LOG

I. GENERAL INFORMATION
Date _____
Plant _____
Unit No. _____
J.R. No. _____
Technician _____
Time Corrective Action Started _____ Hrs.

II. DESCRIBE SYSTEM PROBLEM

III. DESCRIBE ALL CORRECTIVE ACTION TAKEN

IV. RECORD TIME AND DATE CORRECTIVE ACTION WAS COMPLETED

Time _____ HRS.
Date _____

V. THE NEXT DP-30 HOURLY REPORT DATA

Zero Calibration: _____ Span Calibration: _____

	NO	YES
Does zero value exceed acceptable limits of +2.5% opacity?		
Does span value exceed acceptable limits (67.5% to 72.5% opacity)		

Reason Code/Flags (Circle those present on hourly report)

* D M R A

	NO	YES
Is the "M" or "R" Flag present?		

Error Messages on Hourly Report?	NO	YES
1. A/D REFERENCE FAULT		
2. DIGITAL/ANALOG DIFFERENTIAL ALARM		
3. A/D TIME OUT		

IF YES ANSWERS ARE INDICATED FOR ANY OF THE ABOVE QUESTIONS, A JOB REQUISITION SHOULD BE INITIATED

VI. COMMENTS: J.R. No. _____ was initiated

ROUTE: Original to Operating Engr.

EXAMPLE C

_____ STATION

OPACITY MONITOR QUALITY ASSURANCE PROCEDURES

COMPANY, STATION

LSI RM41 OPACITY MONITORING SYSTEM

OVERVIEW OF QA PROCEDURES

A proposed quality assurance program has been developed for the Co. Station opacity monitoring system. The specific QA procedures have been developed to be compatible with the Station (1) opacity monitoring instrumentation and monitoring system configuration, (2) data recording device, (3) effluent handling system, and (4) management and organizational structure. The proposed QA program will be field-tested during implementation, reviewed and evaluated periodically, and revised as necessary over a one-year period. Through this process, it is expected that QA procedures will be developed and demonstrated which are both adequate for maintaining high levels of data quality and cost effective in terms of necessary time and material resource expenditures.

The following elements are included in the proposed Station opacity monitor quality assurance program.

(1) Daily Log, Daily Check Instructions - The Daily Log is to be completed by Operations personnel in the boiler control room. Step-by-step Daily Check Instructions are provided for completing the Daily Log. The Daily Check and Daily Log do not require extensive time to complete, nor do they require that the person performing the procedure be intimately familiar with the opacity monitoring instrumentation. The Daily Check and Daily Log provide for identification of monitoring problems and initiation of corrective action.

(2) Corrective Action Log and Instructions - The Corrective Action Instructions and Log are used when adjustment, repairs, and/or other non-routine corrective action is necessary as indicated by the Daily Checks. The Corrective Action procedures are to be utilized by technical personnel experienced in resolving problems with the monitoring systems. The specific corrective action procedures are relatively extensive, but will provide adequate documentation for future refinement of QA procedures and demonstration of their effectiveness. The corrective action procedures are utilized only on an "as necessary" basis.

(3) Periodic QA Check and Instructions - The Periodic QA check is intended to be performed in conjunction with the opacity monitor routine preventive maintenance program performed three times per year at the Station. The Periodic QA Check procedures provide for checks of monitoring system components and operating status which are unfeasible, impractical, and unnecessary on a daily basis.

(4) The documentation of the QA program will be reviewed periodically to determine if modification to the proposed procedures are appropriate. Such modifications may be made as additional experience and data are obtained.

(5) An attempt will be made to develop a practical method for conducting an annual clear-path check of the Station opacity monitoring system. If successful, this method will be utilized in conjunction with a performance audit of each monitor to be conducted by station personnel during the project and a performance audit to be conducted at the end of the one-year study by the Pilot Project Staff.

COMPANY
STATION

DAILY CHECK INSTRUCTIONS

OPACITY MONITORING SYSTEM
(Lear Siegler, Inc. RM41)

The following are step-by-step instructions for conducting the Daily Check of the Station opacity monitoring systems. Criteria are provided for determining when corrective action should be initiated. The person conducting the Daily Check of each monitoring system should complete all blanks on the Daily Log as indicated below.

I. GENERAL INFORMATION

- o Enter name of person performing check, the date (month, day, year), and the time of day (24-hour clock) that the check is begun.

- o Hours Boiler Down - Enter the number of hours the boiler was not in operation (i.e., not combusting fuel) during the preceding 24-hour period.

- o Hours Monitor Down - Enter the number of hours the monitor did not provide a record of effluent opacity during the preceding 24-hour period. Describe monitor downtime in "Part IV Comments" (i.e., cause of outage, time began, time ended, and any corrective action taken to return monitor to service.)

II. FAULT LAMPS

- o Examine the fault lamps on the Control Unit. Check the appropriate box on the Daily Log to indicate the status of each fault lamp (check "YES" if lamp is illuminated).

III. PANEL METER DATA

- o Rotate the Measurement switch to the "REF" position and record the reference current value (ma) indicated on the 0 to 30 scale.

- o Rotate the Measurement switch to the "COMP" position and record the zero compensation level. (The panel meter readout is in units of optical density, OD.) Return the Measurement switch to the "100% OPACITY" postion.

- o Check the appropriate boxes on the Daily Log to indicate whether the reference and zero compensation values are outside of acceptable limits.

IV. STRIP CHART DATA

- o Examine the strip chart to determine the zero and span responses of the most recent monitor calibration. Record the zero and span calibration values on the Daily Log in units of % opacity.

- o Check the appropriate boxes on the Daily Log to indicate whether the zero and span values are outside acceptable limits.

  Note: IF YES ANSWERS ARE INDICATED FOR ANY OF THE QUESTIONS ON THE DAILY LOG, CORRECTIVE ACTION SHOULD BE INITIATED AS SOON AS POSSIBLE.

V. COMMENTS

- o Describe any problems observed during the performance of the Daily Check and/or any other apparent problems which may affect monitor performance.

- o ENTER THE TIME OF DAY THAT THE DAILY CHECK IS COMPLETED. (Part I)

Opacity Monitoring System

DAILY LOG

STATION

I. GENERAL INFORMATION

Name:_____ Date: _____ Time Start: _____
Time Complete:_____

Hours Boiler Down: _____ Hours Monitor Down: _____

II. FAULT LAMPS

FAULT LAMPS ON?	NO	YES
Filter		
Shutter		
Ref		
Windows		
Over Range		

III. PANEL METER DATA

"REF" value (ma): _____
Zero Compensation (OD): _____

	NO	YES
Does "REF" value exceed acceptable range (17.9-22.2 ma)?		
Does "ZERO COMP" exceed acceptable range (± .018 OD)?		

IV. STRIP CHART DATA

Zero Calibration (% opacity):_____
Span Calibration (% opacity):_____

	NO	YES
Does zero value exceed acceptable limits of ± 2.0% opacity?		
Does span value exceed acceptable limits (32.5 ± 2.0% opacity?)		

IF YES ANSWERS ARE INDICATED FOR ANY OF THE ABOVE QUESTIONS, CORRECTIVE ACTION SHOULD BE INITIATED AS SOON AS POSSIBLE.

V. COMMENTS:

COMPANY, STATION

PERIODIC QUALITY ASSURANCE CHECK INSTRUCTIONS
LSI OPACITY MONITORING SYSTEM

The following are step-by-step instructions for performing the Periodic QA Checks of the . opacity monitoring system. Initially, the Periodic QA Checks are to be performed in conjunction with the routine opacity monitoring system maintenance program performed at least once every four months. The person performing the QA Checks should complete all blanks on the Periodic QA Check Log.

I. GENERAL INFORMATION

- Enter the name of the person performing the check, the date (month, day, year), and the time of day (24-hour clock) that the check is begun.

II. CONTROL UNIT CALIBRATION CHECK DATA

(1) Rotate the Measurement switch to the "REF" position and record the reference current value (ma) on the Log. Return the Measurement switch to the "100% Opacity" position.

(2) Initiate a manual calibration by depressing the "OPERATE/CAL" switch. Record the zero calibration responses (% opacity) of the panel meter and strip chart recorder.

(3) Rotate the Measurement switch to the "COMP" position and record the zero compensation value indicated by the panel meter (OD). Return the Measurement switch to the "100% Opacity" position.

(4) Initiate a span calibration check by depressing the "ZERO/SPAN" switch, and record the panel meter and strip chart span check responses (% opacity) on the Log.

(5) Record the minimum 6-minute average opacity indicated by the chart recorder for the hour period preceding the QA check.

III. TRANSMISSOMETER CHECK/SERVICE

(1) At the monitoring location, check the AGC LED (Automatic Gain Control light emitting diode) on the right hand side of the transceiver, and record whether it is "ON" or "OFF." If the AGC is not illuminated, repairs to the monitoring system must be completed before continuing. (A Corrective Action Log Sheet should be filled out.)

(2) <u>Alignment Check</u> - Remove the plastic cover from the mode switch on the transceiver and turn the switch to the "ALIGN" position. Determine the optical alignment status of the transceiver and retroreflector by looking through the "bull's eye" and observing

whether the image is within the circular target (acceptable), or outside the circular target (unacceptable). Indicate the position of the light beam on the diagram, and check the appropriate box for alignment status on the QA Log.

Open the retoreflector, and determine if the light beam appears to be centered within the port. Indicate the apparent position of the light beam on the diagram and check the appropriate box for retroreflector alignment status on the QA Log.

If the optical alignment is unacceptable, realign the opacity monitoring system in accordance with the manufacturer's instructions. If a shift in the baseline opacity occurs after realignment, note the magnitude of the change which was observed in "Part V COMMENTS."

(3) Inspect and service, as necessary, the purge-air blowers, air filters, and shutter mechanism as per the manufacturer's instructions. Note whether the blower system status is acceptable, and describe any corrective action taken on the QA Log.

(4) Retroreflector Cleaning/Check - Record the average current value (ma) corresponding to the double-pass transmittance indicated by the J-Box meter. Also, record the exact time to allow subsequent determination of the "before cleaning" effluent opacity from the chart record (or have an assistant note the panel meter opacity value if two-way communications are available). Release the retroreflector latches, swing the retroreflector open, and remove all accumulated particulate within the optical path of the monitor. Clean the retroreflector surfaces according to the manufacturer's instructions. Close and secure the retroreflector.

Record the average transmittance indicated by the J-Box meter and the "post cleaning" exact time (or effluent opacity level). Wait at least two full integration periods (12 minutes) before performing step (5) unless an assistant records real time data.

(5) Transceiver Cleaning/Check - Record the average effluent transmittance indicated by the J-Box meter and the exact time (or average effluent opacity). Release the transceiver latches, swing the transceiver open, and remove all accumulated particulate matter from the optical path of the monitor. Clean both the transceiver window and the zero reflector according to the manufacturer's instructions. Close and secure the transceiver.

Record the average effluent transmittance indicated by the J-Box meter and the exact time (or the "post-cleaning" effluent opacity).

(6) Return to the control unit/data recorder station and obtain the average opacity values indicated by the 6-minute chart recorder corresponding to the times recorded on the data sheet (i.e. before and after alignment adjustments, before and after cleaning of the retroreflector, and before and after cleaning of the transceiver).

Record all data on the QA Log. (This step is not necessary if an assistant records real-time opacity values during the QA Check activities.)

(7) Note periods of cleaning on the strip chart record to ensure that these periods will not be later mistaken for excess emissions. Reset alarms if activated during QA Checks. Initiate zero calibration to reset zero compensation and record the post-QA Check zero compensation level (OD) on the QA Log.

(8) Note that the periodic QA Check was performed in the "Part V COMMENTS" section of the Daily Log.

IV. FINAL MEASUREMENTS

(1) Upon completion of all the above steps, record the minimum 6-minute average effluent opacity value displayed on the strip chart for the hour period following completion of all adjustments, repairs, and service for the monitor.

(2) Initiate a manual calibration by depressing the "OPERATE/CAL" switch. Record the final zero compensation value using the procedure detailed in II (3) above.

V. COMMENTS

All observations regarding monitor performance should be explained.

ENTER TIME OF DAY PERIODIC QA CHECK IS COMPLETED (PART I).

Opacity Monitoring System

PERIODIC QA CHECK

COMPANY STATION:

I. Name:_____ Date:_____ Time Start:_____
Time Complete:_____

II. CALIBRATION CHECK DATA

	Panel Meter	Chart Recorder
Reference Current (ma)		
Zero value (% opacity)		
Zero compensation (OD)		
Span value (% opacity)		

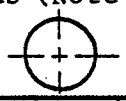
Minimum 6-min. opacity value (hour preceding QA Check):_____

III. TRANSMISSOMETER CHECK/SERVICE

	YES	NO
1. AGC ON?		

See instructions if AGC is not on.

2. Alignment Status (Note position of Light Beam on Diagram)

Transceiver  Retroreflector

Alignment Acceptable?	YES	NO
Transceiver		
Retroreflector		

See instructions if alignment is not acceptable.

3. Blower Status OK?	YES	NO
Transceiver		
Retroreflector		

	TIME	STRIP CHART (% opacity)	J-BOX (% transmittance)
4. Before retroreflector cleaning			
After retroreflector cleaning			
5. Before transceiver cleaning			
After transceiver cleaning			

IV. FINAL MEASUREMENTS

1. Minimum 6-min. opacity value (hour following QA Check):_____
2. Final Zero Compensation value (panel meter, OD):_____

V. COMMENTS:

CO., STATION

CORRECTIVE ACTION INSTRUCTIONS
LSI OPACITY MONITORING SYSTEM

The following are step-by-step instructions for completing the Corrective Action Log when adjustments and/or repairs of the opacity monitoring system are necessary. The person performing the corrective action should complete all blanks on the Corrective Action Log as indicated below.

I. GENERAL INFORMATION

- o Enter the name of person performing repairs or adjustments, the date (month, day, year), and the time of day (24-hour clock) that the corrective action is initiated.

II. SYSTEM/MONITOR FAULTS

- o Enter "ON" or "OFF" for each fault lamp on the Log.
- o Monitor calibration and completion of Part III of the Log is not required if "FILTER" or "SHUTTER" problems initiate the corrective action. However, if the "REF," "WINDOW," or "OVER RANGE" fault lamps are illuminated, the Control Unit data listed in Part III must be obtained prior to adjustment of the monitor.
- o Record the time when the fault is corrected. Describe all corrective action taken in the "Part IV COMMENTS".

III. CONTROL UNIT

(1) Rotate the Measurement switch to "REF" position and record the panel meter ma reading (0 - 30 scale).

If the "REF" is not within acceptable range (green band of panel meter: 17.9 - 22.2 ma), make necessary adjustments, and enter post-adjustment "REF" ma reading on the Log. (If no adjustment is required, enter "NA.")

(2) Rotate the Measurement switch to the "100% OPACITY" position. Depress the "OPERATE/CAL" switch and record the monitoring system zero check responses indicated by both the panel meter and the data recorder (% opacity).

(3) Rotate the Measurement switch to the "COMP" position, and record the zero compensation level displayed by the panel meter in units of optical density (OD).

(4) Cleaning of the transceiver and retroreflector optics and/or other adjustments are necessary when:

(a) zero check response exceeds ± 2% opacity, or
(b) zero compensation exceeds ± .018 optical density.

If no adjustment is necessary, enter "NA" on "Adjusted Zero Value" and "Adjusted Zero Comp" lines of the Log.

Describe all adjustments and/or corrective action in "Part IV COMMENTS." After all adjustments are completed, repeat steps (2) and (3) above and record the post-adjustment zero responses and zero compensation values on the Log.

(5) With Measurement switch on "100% OPACITY" and the monitor in zero check mode, depress "ZERO/SPAN" switch. Record the monitoring system span check response displayed on both the panel meter and the chart recorder (% opacity).

(6) Adjustment of the monitor is necessary if either of the span responses of the monitor exceeds ± 2% opacity from the correct value.

If no adjustment is necessary, enter "NA" on the "Adjusted Span Value" line of the Log. Describe all adjustments and/or corrective action in "Part IV COMMENTS." After all adjustments are completed, repeat step (5) above and record the post-adjustment span response on the Log.

IV. COMMENTS

The reason for initiating corrective action should be stated, and all repairs and/or adjustments performed as a result of the above procedures or as a result of other monitor malfunctions should be described. Sufficient explanation should be provided to determine what was done and what effect it had on monitor performance.

ENTER TIME OF DAY ALL CORRECTIVE ACTION IS COMPLETED. (Part I)

Opacity Monitoring System

CORRECTIVE ACTION LOG

COMPANY STATION:

I. GENERAL INFORMATION

Name:_____ Date:_____ Time Start:_____

Time Complete:_____

II. SYSTEM/MONITOR FAULTS

FAULT LAMPS ON?	NO	YES	CORRECTED	
			Date	Time
FILTER				
SHUTTER				
REF				
WINDOWS				
OVER RANGE				

Note: Monitor calibration and completion of Part III below is not required if "FILTER" or "SHUTTER" problems initiate Correction Action.

III. CONTROL UNIT

	PANEL METER	CHART RECORD
"REF" value (ma)		
Adjusted "REF" value (ma)		
ZERO value (% opacity)		
ZERO comp (OD)		
Adjusted ZERO value (% opacity)		
Adjusted ZERO comp (OD)		
SPAN value (% opacity)		
Adjusted SPAN value (% opacity)		

Note: (ma) and (OD) values from panel meter; all other data from strip chart recorder.

IV. COMMENTS: (Describe adjustments to monitor and/or all other corrective action)

COMPANY
STATION

DAILY CHECK INSTRUCTIONS

OPACITY MONITORING SYSTEM
(Contraves Goerz Model 400)

The following are step-by-step instructions for conducting the Daily Check of the Station opacity monitoring systems. Criteria are provided for determining when corrective action should be initiated. The person conducting the Daily Check of each monitoring system should complete all blanks on the Daily Log as indicated below.

I. GENERAL INFORMATION

- o Enter name of person performing check, the date (month, day, year), and the time of day (24-hour clock) that the check is begun.
- o Hours Boiler Down - Enter the number of hours the boiler was not in operation (i.e., not combusting fuel) during the preceding 24-hour period.
- o Hours Monitor Down - Enter the number of hours the monitor did not provide a record of effluent opacity during the preceding 24-hour period. Describe monitor downtime in "Part IV COMMENTS" (i.e., cause of outage, time began, time ended, and any corrective action taken to return monitor to service.)

II. FAULT LAMPS

- o Examine the fault lamps on the Control Unit. Check the appropriate box on the Daily Log to indicate the status of each fault lamp (check "YES" if lamp is illuminated).

III. STRIP CHART DATA

- o Examine the strip chart to determine the zero and span responses of the most recent automatic monitor calibration. Record the zero and span calibration values on the Daily Log in units of % opacity.
- o Check the appropriate boxes on the Daily Log to indicate whether the zero and span values are outside acceptable limits.

Note: IF YES ANSWERS ARE INDICATED FOR ANY OF THE QUESTIONS ON THE DAILY LOG, CORRECTIVE ACTION SHOULD BE INITIATED AS SOON AS POSSIBLE.

IV. COMMENTS

- o Describe any problems observed during the performance of the Daily Check and/or any other apparent problems which may affect monitor performance.
- o ENTER THE TIME OF DAY THAT THE DAILY CHECK IS COMPLETED. (Part I)

EXAMPLE D

_____ STATION

OPACITY MONITOR QUALITY ASSURANCE PROCEDURES

COMPANY, STATION

CONTRAVES GOERZ MODEL 400 OPACITY MONITORING SYSTEM

OVERVIEW OF QA PROCEDURES

A proposed quality assurance program has been developed for the Co., Lake Road Station opacity monitoring system. The specific QA procedures have been developed to be compatible with the Station (1) opacity monitoring instrumentation and monitoring system configuration, (2) data recording device, (3) effluent handling system, and (4) management and organizational structure. The proposed QA program will be field-tested during implementation, reviewed and evaluated periodically, and revised as necessary over a one-year period. Through this process, it is expected that QA procedures will be developed and demonstrated which are both adequate for maintaining high levels of data quality and cost effective in terms of necessary time and material resource expenditures.

The following elements are included in the proposed Station opacity monitor quality assurance program.

(1) Daily Log, Daily Check Instructions - The Daily Log is to be completed by Operations personnel in the boiler control room. Step-by-step Daily Check Instructions are provided for completing the Daily Log. The Daily Check and Daily Log do not require extensive time to complete, nor do they require that the person performing the procedure be intimately familiar with the opacity monitoring instrumentation. The Daily Check and Daily Log provide for identification of monitoring problems and initiation of corrective action.

(2) Corrective Action Log and Instructions - The Corrective Action Instructions and Log are used when adjustment, repairs, and/or other non-routine corrective action is necessary as indicated by the Daily Checks. The Corrective Action procedures are to be utilized by technical personnel experienced in resolving problems with the monitoring systems. The specific corrective action procedures are relatively extensive, but will provide adequate documentation for future refinement of QA procedures and demonstration of their effectiveness. The corrective action procedures are utilized only on an "as necessary" basis.

(3) Periodic QA Check and Instructions - The Periodic QA check is intended to be performed in conjunction with the opacity monitor routine preventive maintenance program and should be performed once per month at the Station. The Periodic QA Check procedures provide for checks of monitoring system components and operating status which are unfeasible, impractical, and unnecessary on a daily basis.

(4) The documentation of the QA program will be reviewed periodically to determine if modification to the proposed procedures are appropriate. Such modifications may be made as additional experience and data are obtained.

(5) An attempt will be made to develop a practical method for conducting a clear-path check of the Station opacity monitoring system. If successful, this method will be utilized in conjunction with a performance audit of each monitor to be conducted by station personnel during the project and a performance audit to be conducted at the end of the one-year study by the Pilot Project Staff.

Opacity Monitoring System

DAILY LOG

CO. STATION, UNIT

I. GENERAL INFORMATION

Name:_____ Date: _____ Time Start: _____
Time Complete:_____

Hours Boiler Down: _____ Hours Monitor Down: _____

II. FAULT LAMPS

FAULT LAMPS ON?	NO	YES
Stack Power		
Dirty Window		

III. STRIP CHART DATA

Zero Calibration (% opacity):_____
Span Calibration (% opacity):_____

	NO	YES
Does zero value exceed acceptable limits of ± 2.0% opacity?		
Does span value exceed acceptable limits of ± 2.0% opacity?		

IF YES ANSWERS ARE INDICATED FOR ANY OF THE ABOVE QUESTIONS, CORRECTIVE ACTION SHOULD BE INITIATED AS SOON AS POSSIBLE.

IV. COMMENTS:

COMPANY, STATION

PERIODIC QUALITY ASSURANCE CHECK INSTRUCTIONS
CONTRAVES GOERZ MODEL 400 OPACITY MONITORING SYSTEM

The following are step-by-step instructions for performing the Periodic QA Checks of the Unit # opacity monitoring system. Initially, the Periodic QA Checks are to be performed in conjunction with the routine opacity monitoring system maintenance program performed at least once a month. The person performing the QA Checks should complete all blanks on the Periodic QA Check Log.

I. GENERAL INFORMATION

- o Enter the name of the person performing the check, the date (month, day, year), and the time of day (24-hour clock) that the check is begun.

II. CONTROL UNIT CALIBRATION CHECK DATA

(1) Rotate the "MODE" switch on the control panel to the "ZERO" position, and record the zero check responses of the panel meter and chart recorder (% opacity).

(2) Rotate "MODE" switch on the control panel to the "SPAN" position, and record the span check responses of the panel meter and chart recorder (% opacity).

(3) Record the minimum 6-minute average opacity indicated by the chart recorder for the hour period preceding the QA check.

III. TRANSMISSOMETER CHECK/SERVICE

(1) Alignment Check - Determine the optical alignment status of the transceiver and reflector by looking through the alignment sight and observing whether the image is within the circular target (acceptable), or outside the circular target (unacceptable). Indicate the position of the light beam on the diagram, and check the appropriate box for alignment status on the QA Log.

Open the reflector, and determine if the light beam appears to be centered within the port. Indicate the apparent position of the light beam on the diagram and check the appropriate box for reflector alignment status on the QA Log.

If the optical alignment is unacceptable, realign the opacity monitoring system in accordance with the manufacturer's instructions. If a shift in the baseline opacity occurs after realignment, note the magnitude of the change which was observed in "Part V COMMENTS."

(2) Inspect and service, as necessary, the purge-air blowers, air filters, and shutter mechanism as per the manufacturer's instructions. Note whether the blower system status is acceptable, and describe any corrective action taken on the QA Log.

(3) Reflector Cleaning/Check - Record the average effluent opacity value indicated by the transceiver meter. Also, record the exact time to allow subsequent determination of the "before cleaning" effluent opacity from the chart record (or have an assistant note the panel meter opacity value if two-way communications are available). Release the reflector latches, swing the reflector open, and remove all accumulated particulate matter within the optical path of the monitor. Clean the reflector surfaces according to the manufacturer's instructions. Close and secure the reflector.

Record the average effluent opacity value indicated by the transceiver meter and the "post cleaning" exact time (or effluent opacity level indicated at the control unit). Wait at least two full integration periods (12 minutes) before performing step (4) unless an assistant records real time data.

(4) Transceiver Cleaning/Check - Record the average effluent opacity indicated by the transceiver meter and the exact time (or effluent opacity indicated at the control unit). Release the transceiver latches, swing the transceiver open, and remove all accumulated particulate matter from the optical path of the monitor. Clean both the transceiver window and the zero/span chopper according to the manufacturer's instructions. Close and secure the transceiver.

Record the average effluent opacity indicated by the transceiver meter and the "post-cleaning" exact time (or the effluent opacity indicated at the control unit).

(5) Install the "zero jig" on the transceiver and determine the initial response of the monitor (i.e., before any adjustments are performed) at a minimum of three test points (e.g., 0% opacity, 30%-70% opacity, and 100% opacity). Adjustments to the monitor should be performed and a Corretive Action Log completed if the monitor response exceeds ± 3% opacity of the correct test values.

(6) Return to the control unit/data recorder station and obtain the 6-minute average opacity values indicated by the chart recorder corresponding to the times recorded on the data sheet (i.e. before and after alignment adjustments, before and after cleaning of the reflector, and before and after cleaning of the transceiver). Record all data on the QA Log. (This step is not necessary if an assistant records real-time opacity values indicated at the control unit during the QA Check activities.)

IV. FINAL MEASUREMENTS

(1) Note periods of cleaning on the strip chart record to ensure that these periods will not be later mistaken for excess emissions. Reset alarms if activated during QA Checks.

(2) Note that the periodic QA Check was performed in the "Part V COMMENTS" section of the Daily Log.

(3) Upon completion of all the above steps, record the minimum 6-minute average effluent opacity value displayed on the strip chart for the hour period following completion of all adjustments, repairs, and service for the monitor.

V. COMMENTS

All observations regarding monitor performance should be explained.

ENTER TIME OF DAY PERIODIC QA CHECK IS COMPLETED (PART I).

Opacity Monitoring System

PERIODIC QA CHECK

COMPANY STATION, UNIT #

I. Name:_____ Date:_____ Time Start:_____
Time Complete:_____

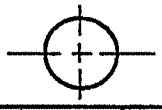
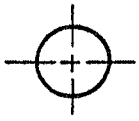
II. CALIBRATION CHECK DATA

	% OPACITY	
	PANEL METER	CHART RECORD
ZERO value		
Adjusted ZERO value		
SPAN value		
Adjusted SPAN value		

Minimum 6-min. opacity value (hour preceding QA Check):_____

III. TRANSMISSOMETER CHECK/SERVICE

1. Alignment Status (Note position of Light Beam on Diagram)

Transceiver  Reflector 

Alignment Acceptable?	YES	NO
Transceiver		
Reflector		

See instructions if alignment is not acceptable.

2.

Blower Status OK?	YES	NO
Transceiver		
Reflector		

		TIME	STRIP CHART (% opacity)	TRANSCEIVER METER (% opacity)
3.	Before reflector cleaning			
	After reflector cleaning			
4.	Before transceiver cleaning			
	After transceiver cleaning			

5. Zero Jig Calibration Data

TEST VALUE % Opacity	MONITOR RESPONSE % Opacity	DIFFERENCE % Opacity
0%		
100%		

IV. FINAL MEASUREMENTS

1. Minimum 6-min. opacity value (hour following QA Check):_____

V. COMMENTS:

CO.,

CORRECTIVE ACTION INSTRUCTIONS
CONTRAVES GOERZ M400 OPACITY MONITORING SYSTEM

The following are step-by-step instructions for completing the Corrective Action Log when adjustments and/or repairs of the opacity monitoring system are necessary. The person performing the corrective action should complete all blanks on the Corrective Action Log as indicated below.

I. GENERAL INFORMATION

- o Enter the name of person performing repairs or adjustments, the date (month, day, year), and the time of day (24-hour clock) that the corrective action is initiated.

II. SYSTEM/MONITOR FAULTS

- o Enter "ON" or "OFF" for each fault lamp on the Log.
- o If the "DIRTY WINDOW" lamp is illuminated, note the minimum 6-minute average effluent opacity which occurs during the one hour period preceding the initiation of corrective action. After cleaning both the transceiver and reflector windows, note the minimum 6-minute average effluent opacity which occurs during the following one hour period.
- o Record the time when the fault is corrected. Describe all corrective action taken in the "Part IV COMMENTS".

III. CALIBRATION DATA/ADJUSTMENT

(1) Rotate the "MODE" switch on the control panel to the "ZERO" position, and record the zero check responses of the panel meter and chart recorder (% opacity).

Cleaning of the transceiver and reflector optics and/or other adjustments are necessary when the zero check responses of either the panel meter or the data recorder exceed $\pm$ 2% opacity. Describe all adjustments and/or corrective action in "Part IV COMMENTS."

(2) Rotate "MODE" switch on the control panel to the "SPAN" position, and record the span check responses of the panel meter and chart recorder (% opacity).

Adjustment of the monitor is necessary if either the panel meter response or chart recorder response exceeds $\pm$ 2% opacity from the correct value. (Correct value of span filter should be labeled on front of control unit.) Describe all adjustments and/or corrective action in "Part IV COMMENTS."

(3) If corrective action requires the installation of the "zero jig" on the transceiver, the initial response of the monitor (i.e., before any adjustments are performed) for the 0% opacity and 100% opacity test points should be recorded on the Log. After all adjustments are completed, the "adjusted" response of the monitor to the 0% opacity and 100% opacity test points should be recorded on the Log.

IV. COMMENTS

The reason for initiating corrective action should be stated, and all repairs and/or adjustments performed as a result of the above procedures or as a result of other monitor malfunctions should be described. Sufficient explanation should be provided to determine what was done and what effect it had on monitor performance.

ENTER TIME OF DAY ALL CORRECTIVE ACTION IS COMPLETED. (Part I)

Opacity Monitoring System

CORRECTIVE ACTION LOG

COMPANY STATION, UNIT #

I. GENERAL INFORMATION

Name:_____ Date:_____ Time Start:_____

Time Complete:_____

II. SYSTEM/MONITOR FAULTS

FAULT LAMPS ON?	NO	YES	CORRECTED	
			Date	Time
STACK POWER				
DIRTY WINDOW				

III. CALIBRATION DATA/ADJUSTMENT

	% OPACITY	
	PANEL METER	CHART RECORD
ZERO value		
Adjusted ZERO value		
SPAN value		
Adjusted SPAN value		

"ZERO JIG" DATA:	0% OPACITY	100% OPACITY
Initial Values		
Adjusted Values		

IV. COMMENTS: (Describe adjustments to monitor and/or all other corrective action)

APPENDIX B.

QUALITY ASSURANCE DATA SUMMARIES

EXAMPLE A

OPACITY CEMS DAILY CHECK RESULTS

MONTH:

MONITOR #

DAY	TIME REQ. (MIN.)	BOILER DOWN (HRS.)	MONITOR DOWN (HRS.)	FAULT LAMPS	ZERO CHART	ZERO LOGGER	SPAN CHART	SPAN LOGGER	COMMENTS/OPERATOR(1)
1	2	0	0		8	9	61	61	
2	2	0	0		9	9	61	61	
3	2	0	0		9	9	61	61	Note: Power surge affecting timer and emissions.
4	2	0	0		9	8	61	62	
5	2	0	0		9	8	61	61	
6									
7									
8	2	0	0		11	8	61	63	
9	2	0	0			8		62	Note: Chart recorder gear broken.
10	3								Note: Data logger not printing 0; manual zero/span ck.
11	2	0	0		9*	9*	61*	62*	Note: Reset cal timer
12	2	0	0		9	8	61	62	
13									
14									
15	2	0	0		10	9	61	62	
16	2	0	0		9	8	62	62	
17	2	0	0		9	8	62	62	
18	3	0	0		9*	9*	61*	62*	
19	2	0	0		9	9	62	62	
20									
21									
22	2	0	0		9		62		Note: Data logger not printing.
23	--	0	0		9	9	62	61	Note: Data logger not printing.
24	2	0	0		9	8	61	62	
25	2	0	0		9	8	61	62	
26	2	0	0		9	8	61	62	
27									
28									
29	2	0	0		10	9	62	62	
30	--	0	0		10	9	61	62	
31	3	0	0		10		61		Note: Data logger timer off Manual zero/span checks.

* Zero and span responses transposed on data sheet.

1983-84 EPA/MODNR PILOT PROJECT
OPACITY CONTINUOUS EMISSION MONITORING SYSTEMS

14:18 WEDNESDAY, OCTOBER 10, 1984 1

1983-84 RM41/DP30 DAILY LOG DATA

UNIT	NAME	MTH	DAY	YR	BOTL_OOS	A_COMP	B_COMP	CHT_ZERO	DAS_ZERO	CHT_SPAN	DAS_SPAN	MALFNCTN Faults	FLAGS	JR_NO	START	COMPLETE	TOTTIME
1	ELAM	6	12	83	0	0.005	0.012	0	0.24	64	70.73	N			500	510	10
1	WIGGINS	6	13	83	0	0.005	0.~~001~~ .01	69	0.44	69	70.66	N			500	510	10
1	WIGGINS	6	14	83	8.5	-0.005	0.~~001~~ .01	69	0.48	69	70.00	N			500	506	6
1	WIGGINS	6	15	83	24	0.005	0.001	69	0.67	69	70.86	S Y	D	110403	500	509	9
1	HAUSAFUS	6	16	83	24	0.005	0.011	.	0.61	69	70.87	S Y	D		512	518	6
1	HAUSAFUS	6	17	83	24	0.005	0.0135	0	0.51	69	70.85	S Y	D		511	515	4
1	HAUSAFUS	6	18	83	21	0.005	-0.005	0	0.91	69	70.67	S,R Y	D		510	515	5
1	HAUSAFUS	6	19	83	4	0.006	-0.007	.	1.22	69	70.63	S,R Y	DM	211452	512	517	5
1	HAUSAFUS	6	20	83	0	0.006	-0.005	.	1.38	69	70.46	S,R Y	DM		511	514	3
1	HAUSAFUS	6	21	83	0	0.007	-0.005	.	1.68	68	70.34	S,R Y	DM		520	525	5
1	BORROR	6	22	83	0	0.009	-0.014	4	2.64	65	71.45	Y			500	506	6
1	BORROR	6	23	83	0	0.006	-0.006	.	0.58	64	70.65	R Y	DM		502	505	3
1	BORROR	6	25	83	0	-0.005	-0.002	0	0.34	64	70.81	N			504	507	3
1	GARNER	6	26	83	0	-0.005	-0.002	0	0.26	69	70.79	N			508	513	5
1	GARNER	6	27	83	0	-0.012	-0.005	0	0.27	69	71.01	N			503	504	1
1	CAUSEY	6	28	83	0 .01	-0.~~001~~	-0.004	0	0.20	68	71.03	N			500	508	8
1	BORROR	6	24	83	0	0.009	0.000	0	0.06	64	70.49	N	.		504	506	2
1	GARNER	6	29	83	0	-0.008	-0.003	0	0.21	69	70.83	N			510	513	3
1	GARNER	6	30	83	0 .01	-0.~~001~~	-0.004	0	0.26	69	70.97	N			507	510	3
1	VOLLMER	7	1	83	0	0.003	0.002	0	0.21	64	70.70	N			510	513	3
1	CAUSEY	7	2	83	0	-0.004	-0.002	0	0.30	66	70.68	N			500	509	9
1	CAUSEY	7	3	83	0	-0.003	-0.003	0	0.26	68	70.70	N			500	508	8
1	CAUSEY	7	4	83	0	0.000	0.000	0	0.16	68	70.53	N			500	506	6
1	CAUSEY	7	5	83	0 .01	-0.~~001~~	-0.004	0	0.18	68	70.95	N			500	507	7
1	CAUSEY	7	6	83	0 .01	-0.~~001~~	-0.005	0	0.17	68	70.95	N			500	510	10
1	CAUSEY	7	7	83	0 .01	-0.~~001~~	-0.005	0	0.22	68	70.92	N			500	506	6
1	BRIDGES	7	8	83	0 .01	-0.~~001~~	-0.003	0	0.14	67	70.92	N			510	515	5
1	BRIDGES	7	9	83	0 .01	-0.~~001~~	-0.004	0	0.19	67	70.90	N			507	511	4
1	BRIDGES	7	10	83	0	-0.009	-0.003	0	0.18	67	70.89	N			520	525	5
1	BRIDGES	7	11	83	0	-0.009	-0.002	0	0.16	68	70.87	N			520	523	3
1	BRIDGES	7	12	83	0	-0.~~0035~~	-0.001	0	0.12	68	70.78	N			510	514	4
1	BRIDGES	7	13	83	0 .01	-0.~~001~~	0.000	0	0.10	68	70.46	N			510	515	5
1	PONETA	7	14	83	0 .01	-0.~~001~~	0.000	0	0.12	68	70.58	N			507	510	3
1	PONETA	7	15	83	0	-0.002	0.005	0	0.15	68	70.63	N			500	508	8
1	PONETA	7	16	83	0	-0.005	-0.001	0	0.17	68	70.67	N			500	510	10
1	COLVIN	7	17	83	0	44 ~~0.044~~	~~0.048~~ 48	0	0.11	68	70.64	N			525	535	10
1	SMITH	7	19	83	0	0.000	0.001	0	-0.03	64	70.33	N			530	535	5
1	SMITH	7	20	83	0	0.000	0.000	0	0.09	63	70.30	Y		216928	525	530	5
1	SMITH	7	21	83	0	0.002	0.001	0	-0.06	63	70.39	Y		216928	540	545	5
1	SMITH	7	22	83	0	-0.002	0.002	0	0.00	66	70.43	Y	D/A	216928	610	615	5
1	SMITH	7	23	83	0	0.008	0.003	0	-0.09	66	70.11	Y		216928	605	610	5
1	HAUSAFUS	7	25	83	0	-0.005	0.000	0	.	68	.	N			510	512	2
1	ELAM	7	26	83	0	-0.005	0.000	0	0.01	68	70.55	N			500	506	6
1	ELAM	7	27	83	0 .01	-0.~~001~~	-0.006	0	0.09	68	70.60	N			512	515	3
1	ELAM	7	29	83	.	0.005	-0.005	-1	0.07	68	70.17	N			506	511	5
1	ELAM	7	30	83	0	0.000	-0.005	0	0.03	67	70.43	N			530	535	5
1	ELAM	7	31	83	24	0.000	-0.005	0	0.07	68	70.40	N			505	507	2
1	BORROR	8	1	83	24	-0.002	-0.007	0	0.12	68	70.50	N			505	509	4
1	BORROR	8	2	83	24	-0.004	-0.006	.	0.09	.	70.49	N		211413	505	508	3
1	BORROR	8	3	83	24	-0.003	-0.007	0	0.13	68	70.49	N			504	507	3
1	BORROR	8	4	83	.	0.000	-0.005	0	0.01	68	70.48	N			509	512	3

Periodic QA check

Periodic QA check

Faults
S = shutter
R = Reference
W = Window
OR = Over Range
F = Filter

Flags
D/A = Digital/Analog
Differential A/D

EXAMPLE B

PRINTED IN U.S.A.

EXAMPLE C

OPACITY CEMS DAILY CHECK RESULTS

MONTH:

DAY	TIME REQ. (MIN.)	FAULT LAMPS	REFERENCE CURRENT (MA)	ZERO METER	ZERO CHART	ZERO COMP (OD)	SPAN METER	SPAN CHART	OPERATOR	COMMENTS
1							32	32		
2	8:00	REF. on	REF. on	-1	-1	-0.02	29	29		Changed transceiver band
	15:30	REF. on	18.3	-1	-1		32.4	32.4		on RM41.
3	6		20	0	0	0	32.4	32.4		
4										
5										
6										
7	7		20	0	0	0	32	32		
8	5		20	0	0	0	32	32		
9	5		20	0	0	0	32	32		
10	5		20	0	0	0	32	32		
11	5		20	0	0	0.002	32	32		
12										
13										
14	5		20.3	1.5	1	-0.005	33.5	33.5		
15	5		20.4	1.5	1	-0.004	33.1	33		
16	5						33	32		
17	5		20.3	1.2	1	-0.005	34	33		
18	5		20.4	1.4	1	0.004	33	33		
19	6		20.4	2.2	2	-0.002	34	34		
20										
21	5		--	2	1.5	-0.002	34	34		
22	5		--	--	--	--	--	--		
23	BLANK									
24										
25	4		20.5	2	1	-0.002				
26										
27										
28	?		20.5	2	1	-0.002	33	32.4		
29										
30										
31										

EXAMPLE D

OPACITY CEMS DAILY CHECK RESULTS

MONTH:

MONITOR #

DAY	TIME REQ. (MIN.)	BOILER DOWN (HRS.)	MONITOR DOWN (HRS.)	FAULT LAMPS	ZERO CHART	ZERO LOGGER	SPAN CHART	SPAN LOGGER	COMMENTS/OPERATOR(1)
1	2	0	0		8	9	49	51	
2	2	0	0		8	9	49	51	
3	2	0	0		8	9	49	51	Note: Reset timer after
4	2	0	0		8	9	49	50	power surge
5	2	0	0	LAMP	8	9	49	50	Note: Maintenance for lamp
6									
7	-								
8	-	0	0	LAMP	Not working				Lamp, plus no zero span
9	2	0	0		12	11	51	50	Manual zero span-auto broke
10	4	0	0		11*	11*	50*	51*	Data logger not printing 0: manual zero/span check.
11	4	0	0		12	50**	51	50	Note: Reset Cal timer
12	2	0	0		10	12	50	51	
13									
14									
15	2	0	0		11	10	51	50	
16	2	0	0		10	11	50	51	
17	2	0	0		10	11	50	51	
18	2	0	0		12	12	50	51	
19	2	24	0		10	10	51	50	Note: Unit 5 tripped
20									
21									
22	-	0	0		10		50		Data logger not monitoring
23	-	0	0		11	10	51	50	Data logger not monitoring
24	2	0	0		10	11	49	50	
25	2	0	0		11	11	50	50	
26	2	0	0		11	11	50	50	
27									
28									
29	2	0	0		10	11	50	51	
30	2	0	0		11	11	49	50	
31	3	0	0		10		61**		Data logger timer off: manual zero/span check

* Zero and span responses transposed on data sheet.

** Recording error; value ignored.

MONTH: UNIT NO.:

DAY	TIME REQ. (MIN.)	BOILER DOWN (HRS.)	MONITOR DOWN (HRS.)	FAULT LAMPS	ZERO METER	ZERO CHART	SPAN METER	SPAN CHART	OPERATOR	COMMENTS
1	7	7	11.5		0	<0	62	64		
2	2				0	<0	64	64		
3	2				<0	<0	64	66		
4	2				<0	<0	66	64		
5	2				<0	<0	64	65		
6	2				<0	0	64	64		Operators continued to mis-read panel meter & data recorder.
7	1				0	0	64	65		
8	1				0	0	65	64		
9	1				0	0	64	65		
10	3	10			0	0	63	65		
11	1	21			0	0	65	66		
12	3	24			0	0	63	65		
13	3	24			0	0	63	65		
14	15	24			0	0	64	64		
15	--	24			0	0	64	64		
16	60	24			0	0	64	64		
17	10	24			0	0	62	64		
18	3	24			0	<0	60	64		
19	3	24			0	<0	61	64		
20	2	24			0	<0	61	64		
21	3	24			0	<0	60	63		
22	2	24			0	<0	62	64		
23	10	24		Window	0	0	60	61		
24	10	24		Window	0	0	60	60		
25	10	24		Window	0	0	60	60		
26	1	24		Window	0	0	60	61		
27	3			Window	0.5	4	61	62		
28										
29						-1		62		
30										Periodic QA/Corrective action.

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO. 68-02-3962	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE RECOMMENDED QUALITY ASSURANCE PROCEDURES FOR OPACITY CONTINUOUS EMISSION MONITORING SYSTEMS		5. REPORT DATE February 1986
		6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) James W. Peeler		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS Entropy Environmentalists, Inc. PO Box 12291 Research Triangle Park, NC 27709		10. PROGRAM ELEMENT NO.
		11. CONTRACT/GRANT NO. 68-02-3962
12. SPONSORING AGENCY NAME AND ADDRESS U. S. EPA, Stationary Source Compliance Division Waterside Mall 401 M Street, SW Washington, DC 20460		13. TYPE OF REPORT AND PERIOD COVERED
		14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

16. ABSTRACT

This report presents recommended quality assurance (QA) procedures for opacity continuous emission monitoring systems (CEMS's) installed at electric utility steam generating stations. The recommended procedures are intended to provide a simple, cost-effective approach to the development and implementation of opacity CEMS QA plans. The approach described here allows for much flexibility in the selection of monitor- and source-specific procedures, the establishment of QA control limits, and the organization of the quality assurance elements. This report identifies and describes the major elements of a QA plan: (1) daily QA checks, (2) periodic QA checks and preventive maintenance, (3) corrective action procedures, and (4) accuracy checks. This report also addresses the organization and interaction of the elements of the QA plan, an approach for optimizing the QA plan, and the assignment of various QA responsibilities.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Air Pollution Monitoring	Opacity Monitoring Systems Continuous Emission Monitoring Quality Assurance Procedures	

18. DISTRIBUTION STATEMENT Release to Public	19. SECURITY CLASS *(This Report)* Unclassified	21. NO. OF PAGES 81
	20. SECURITY CLASS *(This page)* Unclassified	22. PRICE

EPA Form 2220-1 (Rev. 4-77) PREVIOUS EDITION IS OBSOLETE